PHYTOPATHOLOGY

VOLUME IV, 1914

PHYTOPATHOLOGY

OFFICIAL ORGAN OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY

EDITORS

C. L. Shear — L. R. Jones — R. A. Harper

ASSOCIATE EDITORS

G. P. Clinton — H. T. Güssow — W. M. Scott
M. T. Cook — F. D. Heald — A. D. Selby
B. M. Duggar — C. J. Humphrey — F. C. Stewart
E. M. Freeman — W. A. Orton — Roland Thaxter

BUSINESS MANAGER

Donald Reddick.

VOLUME IV

JANUARY-DECEMBER, 1914

With 27 Plates, and 45 Text Figures

Published for the Society
Williams & Wilkins Company
Baltimore, Md.

INDEX TO VOLUME IV

New scientific names are printed in full-faced type

Abies, 181, 271; amabilis, 184; arizonica, 184; balsamea, 186, 187; concolor, 33, 182, 183, 184; grandis, 66, 184, 272, 273, 274, 275, 276; lasiocarpa, 182, 184; magnifica, 182, 183, 184, 186; new host of Fomes laricis, 33; nobilis, 184, 186; shastensis, 182, 183, 184, 187

Abutilon, 393

Acer, 274; glabrum, 274, 276; rubrum, 186, 187, 188; saccharinum, 184, 185, 186; saccharum, 185, 275

Acetic fermentation, following soft rot of sweet potato, 312

Acid injury, dicotyledonous weeds, 92; pine seedlings, 91

Acrocystis, batatas, 405.

Acrostalagmus, 393, 396

Actinomyces, 405; chromogenus, 405; scabies, 396

Actinopelte japonica, cause of leaf spot of oak new to America, 396

Aecidium, 261, 263; blasdaleanum, 41, 261, 262, 263, 266, 267; pourthiaeae, 262

Aesculus hippocastanum, perfect stage of leaf spot fungus on, 399

ADAMS, J. F., see ORTON, C. R.

Agave, 75

Agropyron caninum, 411; repens, 411, inoculations from barberry rust, negative, 22, inoculations from uredospores of timothy rust, negative, 22; smithii, 411; tenerum, 411, artificial infections from barberry, 21

Agrostis alba, 110, 111, 411; stolonifer, 411

Almond, 75

Alnus, 276; glutinosa, 275; oregona, 184; tenuifolia, 184, 275, 276

Alternaria, 297, 403, 405, 406, relation to fruit spot of apple, 102–105, 334, to shedding of cotton bolls, 328, 330; citri, 54

Amaranthus retroflexus, Cystopus bliti on, 57

Amelanchier, 339, 398; alnifolia, 261, 266, 267, 340; canadensis, 262; florida, 41, 261; pallida, 261; vulgaris, 262

American Phytopathological Society, report of fifth annual meeting, 36

Ammonium copper carbonate, use for damping-off, 79, 80, 81

Ampelopsis tricuspidatum, Cladosporium disease of, 42, 189

Amygdalus persica, 187

ANDERSON, H. W., Peronospora parasitica on Arabis laevigata, 338

Andropogon hallii, 108, 111; nutans, 109

Anthaenantha rufa, 108, 111

Anthoxanthum odoratum, 411

Anthracnose, apple, 217; Asclepias speciosa, 410; cotton, 42; grasses, 106; raspberry, 407

Ants, in rot cavities, 385

Apple, 398; anthracnose, 217; Baldwin spot, 121; bitter pit, 121, 402; blossom blight, 27–30, per cent in Missouri, 29; blossom rot, 403; collar rot, 43; core rot, 403; Fomes fomentarius on, 339; Fomes pinicola on, 275; frog eye, 396; fruit pit, 121; fruit spot, 333; Jonathan spot, 102–105, 334, 402, 403, 406; leaf spot, 396; Melanops quercuum on, 49; rots, 403; rust, 261, 264, 401; scab, 52, barium sulphid as spray for, 412, lime-sulphur as spray, 42, sulphur as spray, 44; scald, 403; Sclerotinia, inoculations with, 99; skin-crack, 405; stigmonose, 402, 403; Stereum hirsutum on, 275; stippen, 121; sulphur as spray for, 394; Wealthy spot, 333; York spot, 405

Apple-tree borer, relation to spread of collar rot, 43

286673

Arabis laevigata, 338
Aralia quinquefolia, 376
Armillaria mellea, 276; on potatoes, 322
Arrhenantherum elatinus, 110, 111
ARTHUR, J. C., A Gymnosporangium with repeating spores (abstract), 408
Arundinaria, 108, 112
Asclepias speciosa, new Colletotrichum on, 410
Ascochyta, 39; chrysanthemi, 378; hortorum, 38; parasitica, 64; piniperda, on spruce seedlings, 63, 64
Ascospore expulsion, 255–257; relation to temperature in Endothia parasitica, 52
Ascospore traps, 52
Aspidiotus perniciosus, introduction from China, 15
Asparagus, 75; rust, 14
Aspergillus niger, 403
Aster, 25
Avena sativa, 111

Bacillus amylobacter, 31; amylivorus, 31, 32; amylovorus, 27, 31, 33, cause of collar rot of apple trees, 43; cubonianus, 34; phytophthorus, 277; solanacearum, 277, 278
Bacterial disease, Erodium and Pelargonium, 221
Bacterial wilt, potato, 277; tomato, 278
Bacteriosis, potato, 278; tomato, 278
Bacterium erodii, 231, aerobism, 228, cultural characteristics, 224, growth in fermentation tubes, 229, inoculation experiments, 223, isolation, 223, moisture relation, 228, morphology, 229, sensitiveness to acids and alkalies, 229, thermal relations, 227; mori, 34
BAILEY, F. D., Notes on potato diseases from the Northwest, 321–322
BAILEY, I. W., see SINNOTT, E. W.
Barberry, rust, 21; positive artificial infections, 21; negative results, 22
Barium polysulphide, use as spray for apple scab, 412; for peach scab, 412
Bark disease, white pine, 376
Barley, 411; Helminthosporium diseases of, 46, 408; smuts, control by hot water treatment, 45, by formaldehyde, 46
BEATTIE, R. KENT, The use of lime sulphur wash as a remedy for apple scab (abstract), 42; The Citrus canker situation (abstract), 397; The organization of the plant disease survey (abstract), 403
Beech, see Fagus
BERG, ANTHONY, see GIDDINGS, N. J.
BESSEY, ERNST, Tylenchus dipsaci in the United States, 118
Betula, 272, 274, 339; fontinalis, 184, 185; lenta, 184, 186, 275; lutea, 184; nigra, 186; occidentalis, 184, 185, 272, 273, 274, 275, 276; papyrifera, 184, 185, 186, 187
Bibliographical citations, 53
Biological strains, Sphaeropsis malorum, 45
Biota, 375
Birch, see Betula
Bordeaux mixture, basic sulphates formed in, 151; chemistry of, 128; colors of, 151; for damping-off, 80; history of, 125; hot-bed disinfection, use for, 303; keeping qualities, 133; preparations or properties, 172–178; physical properties, 145–172; settlement of, 152; strength of mixtures, 128; types of, 172; weathering of, 138
Bitter pit, apple, 121, 402
Bitter rot, apple, 217; see also Glomerella
Black gum, 39
Black head of grain, 190
Black knot, histology of, 402
Black-leg, 40; cabbage, 46; Cruciferae, 46; potato, 277
Black rot, cabbage, 401; grape, 13; sweet potato, 50, 279, 305
BLAKESLEE, A. F., An improved method of making separation cultures (abstract), 43
Blight, apple, 31, 32; pear, 31, 32; spruce seedlings, 63
Blight canker, 27
Blight organism, spelling of specific name, 32–33
Blind staggers, caused by Rhizopus on corn, 306
Blister rust, pine, 41

BLODGETT, F. M., Comparative dusting and spraying experiments (abstract), 44; further studies on the spread and control of hop mildew (abstract), 400
Blossom blight, apple, 27; per cent on varieties in Missouri, 29
Blossom-end rot, tomato, 49, 345; enzymes, relation to, 348; fertilizers, effect of, 357; histology of, 368; lime, effect of, 364; moisture, effect of, 351; organisms, relation to, 347; soil relation, 356; rapidity of development, 367; sugar, effect of, 363; susceptibility of varieties to, 350
Blossom rot, apple, 403
Boll disease, cotton, 327
Botrytis, 72, 75, 393; cinerea, 403; douglasii, 65, 66, 74; vulgaris, cause of lemon gummosis, 54
BURKHOLDER, W. H., The perfect stage of the fungus of raspberry anthracnose (abstract), 407
Burl disease, Pinus virginiana, 6
BURRILL, T. J., Bacillus amylovorus vs. amylivorus, 31
BUTLER, O., Bordeaux mixture: I. Physico-chemical studies, 125–180
Brachiaria digitarioides, 111
Bromus inermis, 22; secalinus, 111; uniolioides, 109, 111
BROOKS, CHARLES, Blossom-end rot of tomato (abstract), 49, 345–374; and FISHER, F. D., Jonathan spot, bitter pit and stigmonose (abstract), 402; and FISHER, F. D., and COOLEY, J. S., Apple rots, (abstract), 403
Brown blotch, pear, 394
BROWN, NELLIE A., A snapdragon wilt due to Verticillium, 217
Brown rot, the fungus, 93–101, 398; apothecia, time of appearance, 98, character of asci and ascospores, 99; conidia, germination of, 95–98, size, 98, time of appearance, 98; hosts, 398; inoculation experiments with, 99
Brown-tail moth, see Euproctis chrysorrhoea
BYARS, L. P., A destructive nematode introduced into the United States (abstract), 45; Preliminary notes on the cultivation of the plant-parasitic nematode, Heterodera radicicola, 323–326

Cabbage, 75; black rot, 401; black-leg, 46; disease resistant, 47; Fusarium disease, 47; Sclerotinia on, 75; yellows, 47, relation of temperature to infection, 404, resistance to, 404
Calamagrostis canadensis, 411; epigeum, 108, 111
Canker, chestnut, 191, 233, 234
Camellia, blight, 376
Capsella bursa-pastoris, 47
Capsicum annuum, 287, 296
Carnation, stem rot, 406
CARPENTER, C. W., The Verticillium wilt problem (abstract), 393; a method of excluding mites from pure cultures (abstract), 394
Castanea crenata, resistance to bark disease, 15; dentata, bark disease of, 15
Castanopsis chrysophylla, infected by Cronartium quercus, 8
Cauliflower, 75
Cedar rust, 262, 263
Cedar, yellow, rust on, 408
Celery, bacterial leaf spot, 395; decay in storage, 45; late blight, 45; pink rot, 45; Sclerotinia libertiana on, 45; Septoria petroselina on, 45
Cenchrus tribuloides, 108, 111
Cephalothecium roseum, 328, 329, 403
Cereal rusts, relation of grass rusts to, 411
Cercospora personata, on peanut, 397
Certification of potato seed stock, 39
Chaetostroma, 106
Chamaecyparis lawsoniana, 375; nootkatensis, 262
Charcoal rot, sweet potato, 50, 305
Chemicals, gum formation induced by, 53
Chenopodium album, 204, 205
Cherry, 398; black knot on, 340; inoculations with Sclerotinia, 99
Chestnut, American, bark disease of (see Endothia parasitica); disease, little-known, 49; injection of trees with chemicals, 412; structure of normal wood and bark, 191; of wood and bark affected by Endothia, 191

Chestnut, Italian, Polyporus on, 273
Chestnut-blight fungus, insects as carriers of, 52; longevity of pycnospores in soil, 51; wind, dissemination of, 51
Chestnut oak, canker of, 44
Chrysopogon nutans, 109, 111
Chytridium, 55, 56; pollinis pini, 56; vagans, 56
Citations, bibliographical, 53
Citrus, canker, 397; fungous gummosis of, 54; gum formation induced by chemicals, 53; Pestalozzia blight, 376; trifoliata, canker of, 397
Cladosporium, 54, 64; carpophilum, 49, 408; fulvum, 189, 398; herbarum, 42, 190; uvarum, 42, 190
Classification of fungi, 119
Clavaria muscigena, 407
Claviceps, triseptate spores in, 386
Clematis jackmani, 39; paniculata, 39
Clover, alsike, disease of, 410
Clover, red, disease of, 410
Coconut, leaf disease, 376
Coleosporium, 25; inconspicuum, 6, 9
Collar-blight, apple trees, 43
Collar-rot, apple tree, 43
Colletotrichum, 106, 110, 411; bromi, 109, 110; cereale, 106, 107, 108, 109, 110; **graminicolum**, 110; lineola, 107, 109, 112; lineola pachysperma, 109, 110, 112; new species on clover, 410, on Asclepias, 410, on potato, 410; sanguineum, 110, 112; trifolii, 410
Comandra umbellata, 25
Commerce, relation of plant disease to, 18
Comptonia asplenifolia, 23, 409; peregrina, 23
Conel, J. L., A study of the brown-rot fungus in the vicinity of Champaign and Urbana, Illinois, 93–101
Conferva bombycina, Rhizophidium on, 56
Conifers, damping-off of seedlings, 73–85; diseases of, 181, 184; fungicides for damping-off, 89–92; wood-destroying fungi on, 271
Cook, Mel T., Notes on economic fungi, 201–203; The southern bacterial wilt in New Jersey, 277–278; A Nectria parasitic on Norway maple (abstract), 396; and Martin, G. W., The Jonathan spot rot, 102–105; Orchards experiments in 1914 (abstract), 394; and Schwarze, C. A., A nursery disease of the peach (abstract), 394; and Wilson, Guy West, Cladosporium disease of Ampelopsis tricuspidatum, 189–190
Cooley, J. S., see Brooks, Charles
Copper, colors of the basic sulphates, 148; physical properties of the basic sulphates, 148
Copper sulphate, damping-off, test for, 78, 80, 89, 90, 91, 92; gum formation induced by, 53; per cent in various Bordeaux mixtures, 128
Corn, 75; smut, infection experiments, 411
Corrosive sublimate, for seed disinfection, 303
Corticium, 406; vagum solani, 38, 203, 406
Coryneum beyerinckii, 54
Cotton, 75; anthracnose, 42; dropping of bolls, 327; Verticillium wilt, 393
Cotton plants, lightning injury, 406
Crab apple, 398; inoculations with Sclerotinia on, 99
Crab flowering, rust on, 265
Crab, wild, affected by blossom-blight, 29
Crabill, C. H., Notes on a fungous parasite of the San José scale, 217; A mutation in Phyllosticta (abstract), 396
Crane's bill, wild, bacterial disease of, 221
Crataegus, 41, 262, 272, 398; cerronis, 262; coccinea, 186; crus-galli, 30; douglasii, 261, 263, 266, 267, 276; rivularis, 261; tomentosa, 262
Creonectria ipomoeae, 280
Cromwell, R. O., see Fulton, H. R.
Cronartium comandrae, 24, 25; comptoniae, 8, 23, 409; quercus, 6; ribicola, 43, 409
Crown gall, on poplars, 201
Crown rot, apple trees, 43
Cruciferae, affected by black-leg, 46

Cultures, methods with Fusaria, 286; nematodes, 323; separation, improved method of making, 43; of sterile host plants, 326
Curly dwarf, potato disease, 40
Currant, Cronartium ribicola on, 43
Cydonia japonica, 267, 398; vulgaris, 41, 266
Cylindrosporium pomi, 121
Cypress, pecky, 39
Cystopus, 55, 59; bliti, 57, 59, 60; candidus, 60; cubicus, 60; ipomoeae-panduranae, 51
Cytispora abietis, 64
Cytospora, 251

Dactylis glomerata, 108, 111, 411
Dahlia, 75; Verticillium disease of, 40, 393
Damping-off, coniferous seedlings, 73–87; use of disinfectants for control of, 89
Decaying wood, method of anatomical study, 403
Deciduous trees, wood-destroying fungi of, 271
Dentaria laciniata, 338
Desiccation, effect on spores of Endothia parasitica, 401; resistance of sporidia of corn smut to, 412
Dewberry, 75
Diaporthe, 293; batatis, 297, 300, 312
Dicladium graminicolum, 106, 110, 112
Diplodia gossypii, 47; natalensis, 47
Disease control, biological basis of, 11; environmental influences, effect on, 16; international view point of, 16; international coöperation in, 18
Disease resistance, cabbage, 47; tobacco, 48
Disinfectants, damping-off, use for, 89; soil, 398
Dissemination, chestnut blight fungus, by wind, 51, by insects, 52; stem rot, sweet potato, 301
Distichlis stricta, 204, 205
Douglas fir, 186
Downy mildew, grape, see Plasmopara viticola

Drechsler, Charles, Cotyledon infection of cabbage seedlings by the bacterial black rot (abstract), 401
Drought, effect on potatoes, 395
Dry rot, Fusarium, 40
Dusting, compared with liquid spraying, 44

Eastham, J. W., Bitter pit investigation by D. McAlpine (Review), 121–123
Echinochloa crus-galli, 106, 111
Echinodontium tinctorium, 271
Economic fungi, notes on, 201–203
Edgerton, C. W., A method of picking up single spores, 115–117
Eel worm, 40
Egg plant, rots of, 38; stem rot, 279, 317; Verticillium wilt, 40, 393
Elm, 39
Endothia, 191, 233; canker, 191, 233, 234; gyrosa, 251; parasitica, 51, 52, 191, 233, 236, depth of penetration, 200, growth of cankers, 249, longevity of spores, 401, inoculation, 238–248, morphology, 250–259, origin from China, 15, pathogenicity, 236–238; radicalis, 238, 244
Endothiella, 251
Environmental influences, effect on spread of diseases, 16
Eocronartium typhuloides, 407
Ericaceae, 70
Erodium, 221; texanum, 221, 222, 231
Euphorbia, 75
Euproctis chysorrhoea, introduction from Europe, 14
Expulsion of ascospores, 407

Fagus atropunicea, 184, 185; ferruginea, 275; silvatica, 275
Farm animals, agents in dissemination, stem rot, sweet potato, 301
Farm implements, agents in dissemination, stem rot, sweet potato, 301
Fawcett, H. S., Fungous gummosis of citrus in California (abstract), 54
Ferrous sulfate, for damping-off, 90
Fertilizers commercial, effect on blossom-end rot of tomato, 309
Festuca, 109, 111; heterophylla, 109, 111
Field, Ethel C., see Harter, L. L.

Filiform leaf, tomato, 42
Fir, "conky," 33; Douglas, 273, 375
Fire blight, 27, 32
Fisher, F. D., see Brooks, Charles
Fitzpatrick, Harry M., The parasitism, biology and cytology of Eocronartium typhuloides Atk. (abstract), 407
Floyd, B. F., Gum formation in citrus as induced by chemicals (abstract), 53
Fomes, 184; annosus, 275; applanatus, 185, 186, 339; fomentarius, 185, 339; geotropus, 39; igniarius, 185, 339; laricis, 271; leucophaeus, 275, 339; marginatus, 184, 275; pinicola, 184, 275; roseus, 186, 187; ulmarius, 39; ungulatus, 184
Formaldehyde gas, injury to potato tubers, 38
Formalin, for damping-off, 77, 78, 80, 81, 82, 89, 90, 91, 92
Fromme, F. D., Negative heliotropism of urediniospore germ-tubes of Puccinia rhamni (abstract), 407
Frost injury, to Picea rubens, 69
Fruit rot, 306; egg plant, 38; peanut, 397
Fruit spot, apple, 333
Fruits, plaster casts of, 113
Fulton, H. R., Winston, J. R., and Cromwell, R. O., Cotton anthracnose: Some field problems and some field experiments (abstract), 42
Fungicide, new, 412
Fungicides, tests of for damping-off, 77–82, 89–92
Fungus, undetermined ascomycete, 202
Fusarium, 54, 74, 76, 279, 282, 300, 313, 317, 348, 405; acuminatum, 297, 299; batatis, 50, 51, 284–293, 296–300, 303, 305, 306, 312, 314, 317; on cabbage, 47; caudatum, 285, 287, 295, 297, 303; caudatum volutum, 297, 299; coerulium, 44, 297; conglutinans, 404; culture methods, 286; dry rot, cause of, 40; damping-off of pine seedlings, cause of, 89; erubescens, 345; hyperoxysporum, 285–293, 296, 297, 298; incarnatum, 297, 299, 300; inoculation experiments, on sweet potato, 287, on other hosts, 287; marti, 44; metachroum, 44; moniliforme, 76; natural classification of the species, 44; orthoceras, 284, 287, 295, 297, 303; orthoceras triseptatum, 297, 299; oxysporum, 44, 277, 284, 285, 287, 294, 295, 297, 299, 303; pure cultures from various hosts, 75; putrefaciens, 403; radicicola, 285, 287, 295, 297, 303, 403; solani, 44, 300; solani medium, 297; trichothecioides, 44; vasinfectum, 393, on okra, 40; wilt, 40, 393
Fusoma parasiticum, 75

Galloway, B. T., Pierre-Marie-Alexis Millardet, 1
Gallowaya pini, 6, 9
Gardner, M. W., Longevity of pycnospores of the chestnut blight fungus in soil (abstract), 51; see also Heald, F. D.
Geranium, bacterial disease, 221
Gibberella saubinetii, 285, 287, 288, 295, 297, 303
Giddings, N. J., and Berg, Anthony, Field studies of apple rust (abstract), 401
Gilbert, E. M., Fungus-host relationship in black knot (abstract), 402
Gilbert, W. W., see Jones, L. R.
Gilman, J. C., The relation of temperature to the infection of cabbage by Fusarium conglutinans Wollenw. (abstract), 404
Ginseng, 33; Phytophthora on, 44; wilt of, 393
Gliocephalum, 393
Gliocladium, 393
Gloeoporus, 274; conchoides, 274
Gloeosporium venetum, 407
Glomerella, 115, 116; cingulata, 403; rufomaculans, 218, 219
Gloyer, W. O., Stem rot and leaf spot of Clematis (abstract), 39; see also Stewart, F. C.
Golden seal, nematodes on, 33
Gooseberry, mildew, 14
Grain, black head, 190
Grape, 75; Cladosporium on, 190
Grape fruit, canker, 397
Grasses, anthracnose of, 106–112

Grass rusts, relation to cereal rusts, 411
GRAVES, ARTHUR H., Notes on diseases of trees in southern Appalachians. II, 5; III, 63; Fomes laricis in California, 33
GREGORY, C. T., Studies on Plasmopara viticola (abstract), 399
Guignardia bidwellii, introduction into France, 13
Gum diseases, of Citrus, 54
Gum formation, induced by chemicals, 53
Gummosis, induced by fungi in Citrus, 54
Güssow, H. T., Triseptate spores in Claviceps, 386
Gymnosporangium blasdaleanum, 41, 261, 262, 263, 266, 267, 268; libocedri, 262; sorbi, 262
Gypsy moth, 14

HARTER, L. L. and FIELD, ETHEL C., The stem rot of the sweet potato (Ipomoea batatas), 279–304
HARTLEY, CARL, Notes on soil disinfection (abstract), 398; and MERRILL, T. C., Preliminary tests of disinfectants in controlling damping-off in various nursery soils, 89–92
Haw, blossom blight on, 29
HEALD, F. D., A little-known disease of chestnut and oak trees (abstract), 49; and STUDHALTER, R. A., The longevity of pycnospores and ascospores of Endothia parasitica under artificial conditions (abstract), 401; and GARDNER, M. W., and STUDHALTER, R. A., Wind dissemination of ascospores of the chestnut blight fungus (abstract), 51
Heart rot, 185, 186, 271; of Picea rubens, 69; of Pinus virginiana, 9
HEDGCOCK, G. H., Notes on some diseases of trees in our national forests, IV, 181–188
Heliotropism, negative, of germ tubes of Puccinia rhamni, 407
Helminthosporium gramineum, 46; sativum, 46; teres, 46, 408
Hemlock, diseases of, 69–72; leaf rust, 70; timber rot, 69: twig blight, 70
HENDERSON, M. P., Some observations and experiments on the black-leg disease of cabbage (abstract), 46
Herbaceous plants, lightning injury to, 406
Herpotrichia nigra, 71, 181, 182, 183
HESLER, L. R., Biological strains of Sphaeropsis malorum (abstract), 45
Heterodera radicicola, cultures of, 323; schachtii, 326
HEWITT, J. LEE, A disease involving the dropping of cotton bolls, 327–332
Heyderia decurrens, 41, 262, 263, 266
HIGGINS, B. B., A wilt disease of Japanese and hybrid plums (abstract), 398
Histology, pathological of the Endothia canker, 191–200
Holcus lanatus, 107, 111
Hollyhock, rust, 15
Hop, mildew, 400
Hordeum jubatum, 411, inoculations from barberry rust, 21; vulgare, 110
HORNE, WM. T., Note on organization of the Western American Phytopathological Society, 386
Horse chestnut, leaf blight, 399
Humidity, relation to fungous diseases, 16
HUNGERFORD, CLAS. W., Wintering of timothy rust in Wisconsin, 337–338
Hyacinths, nematodes on, 45
Hydnum caput-ursi, 272; coralloides, 272; erinaceus, 272
Hydrochloric acid, for damping-off, 89
Hydrocyanic acid, injurious to tobacco, 118
Hymenochaete tabacina, 272
Hypochnus solani, 406
Hypomyces ipomoeae, 280

Ice, damage to scrub pine, 10
Infection experiments, corn smut, 411; peach scab, 408
Injection of chemicals into chestnut trees, effects of, 412
Inoculation experiments, barberry rust on various hosts, 21; brown-rot fungus, 99; Fusaria, 287; Pestalozzia, 380; timothy rust on various hosts, 21

Insects, agents in dissemination, stem rot of sweet potato, 301; carriers of the chestnut-blight fungus, 52; hymenopterous in rot cavities caused by Trametes pini, 385
Inspection, potato seed stock, 39
International Institute of Agriculture, 11
Ipomoea batatas, 287, 298, stem rot of, 279; coccinea, 287, 296; hederacea, 285, 287, 293, 296, 303; lacunosa, 287, 296; purpurea, 287, 296

Jackson, H. S., A new rust of economic importance occurring on pomaceous hosts (abstract), 41; A new pomaceous rust of economic importance, Gymnosporangium blasdaleanum, 261–269
Jaczewski, A. A. von, Classification of fungi (Review), 119
Jagger, Ivan C., A bacterial leaf spot disease of celery (abstract), 395
Java black rot, sweet potato, 50
Jennison, H. M., Symbols vs. terminology in ascomycetes, 216
Johnson, A. G., Experiments on the control of certain barley diseases (abstract), 46; The ascigerous stage of Helminthosporium teres Sacc. (abstract), 408
Johnson, James, Disease resistance in tobacco to root-rot (abstract), 48; Resistance in tobacco to hydrocyanic acid gas injury, 118
Jonathan spot, 402, 403, 405, 406
Jones, Fred R., Perithecia in cultures of Venturia inaequalis (abstract), 52
Jones, L. R., Progress in developing disease resistant cabbage (abstract), 47; Third progress report on Fusarium resistant cabbage (abstract), 404; and Gilbert, W. W., Lightning injury to cotton and potato plants (abstract), 406
Juniperaceae, 408
Juniperus, 181, 375; californicum, 187; communis, 182, 183; monosperma, 187; occidentalis, 187; pachyphloea, 187; sabinoides, 187; utahensis, 187; virginiana, 187, 274

Keefer, W. E., Pathological histology of the Endothia canker of chestnut, 191–200
Keitt, G. W., A preliminary report on fruit infection of the peach by means of inoculations with Cladosporium carpophilum Thüm. from peach twigs (abstract), 49; a preliminary report on twig and leaf infection of the peach by means of inoculations with Cladosporium carpophilum Thüm. (abstract), 408

Laestadia aesculi, 399
Lappa major, 142
Larix laricina, 184, 187; lyalli, 184, 186; occidentalis, 66, 184, 187, 272, 273, 274
Lasiodiplodia, non-validity of the genus, 47; nigra, 47; tubericola, 47, 50
Late blight, potato, 54
Late spring, relation to blossom blight, 30
Lead arsenate, 44
Leaf anthracnose, ginseng, 376
Leaf cast, Pinus virginiana, 9
Leaf roll, potato, 40
Leaf rust, hemlock, 70
Leaf spot, celery, 385; Clematis, 39; peanut, 397; sweet potato, 51, 320
Leaf spots, photographing, 215
Leak, potato, 306
Lemon, gummosis of, 54
Lenzites sepiaria, 275
Lepidium virginicum, 47
Leptostylus macula, 52
Lewis, I. M., A bacterial disease of Erodium and Pelargonium, 221–231
Libocedrus decurrens, 41, 182, 183, 262
Lightning, injury to cotton and potato plants, 406
Lime, effects on blossom-end rot of tomato, 364; powdered with copper sulphate, tested for damping-off, 77, 79; ratio to copper sulphate in various Bordeaux mixtures, 128
Lime-sulphur, 44; for apple scab, 42; for damping-off, 80
Lint, H. Clay, The use of sulphur for the control of potato scab (abstract), 396

Liriodendron, 274
Literature on plant diseases, 207–214, 341–344, 388–391, 414–417
Lolium perenne, 107, 111
LONG, W. H., A preliminary note on the cause of "pecky" cypress, 39
Longevity of pycnospores of chestnut blight fungus in soil, 51; of spores of Endothia parasitica under artificial conditions, 401; of mycelium of Rhizopus, 312
Lycopersicum esculentum, 287, 296

Macrosporium, 64, 297, 348; solani, 345; tomato, 345
Magnolia, 39; foetida, Pestalozzia blight of, 376
Mal di gomma, 54
Malus floribundus, 41, 265, 267; malus, 41, 267; rivularis, 41, 262, 265, 266, 267
Manure, dissemination agent, stem rot of sweet potato, 301; effect on blossom-end rot, tomato, 357
Maple, 39, 185; Nectria on, 396; root disease, 40; thrombotic disease, 395
MARTIN, G. W., Orchard experiments with Jonathan spot rot in 1914 (abstract), 406; see also COOK, MEL T.
MASSEY, A. B., Citrus canker (abstract), 397
MCCLINTOCK, J. A., Is golden seal resistant to the root knot nematode? 33
MCCUBBIN, W. A., Photographing leaf spots, 215; For washing small objects, 216
MCKAY, M. B., see POOL, VENUS W.
MEHLUS, I. E., A Phoma rot of Irish potatoes (abstract), 41; a study of the annual recurrence of Phytophthora infestans (abstract), 54; a species of Rhizophidium parasitic on the oospores of various Peronosporaceae, 55
Melanops quercuum, perfect stage of Sphaeropsis malorum, 49; quercuum vitis, 48, 49
MELCHERS, LEO E., The plaster cast apple specimen, 113–114
Melica uniflora, 107, 108, 111
Melilotus, stems for culture of Fusaria, 286
Melters, potatoes, 306
MERCER, W. H., Investigations of timothy rust in North Dakota during 1913, 20
Mercuric chloride, for damping-off, 90
MERRILL, T. C., see HARTLEY, CARL
Micrococcus amylovorus, 31, 33
Mildew, hop, 400
MILLARDET, PIERRE-MARIE-ALEXIS, biography of, 1
Milkweed, anthracnose of, 410
Mites, exclusion from pure cultures, 394
Monilia, 403
Moniliochaetes infuscans, 405
Morning glory, wild, 303
Mosaic, 42; disease of tomato, 398
Moss, fungus parasite of, 407
Mucor, 54, 55; stolonifer, 403
Mulberry blight, organism of, 34; identity of French and American, 34
MURRILL, W. A., How to know the Polypores (abstract), 409
Mutation in Phyllosticta, 396
Myrica asplenifolia, rust on, 9

Nectria, 279, 317, 340, 396; cinnabarina, 339, 340, 396; coccinea, 396; ipomoeae, 50, 279, 280, 284, 285, 287, 288, 289, 298, 303, 313, 314, 317
Nematodes, cultivation of, 323; on golden seal, 33; on hyacinths, 45; on oats, 118; on rye, 118; on various hosts, 45
Neocosmospora vasinfecta, 397
Neofabrea malicorticis, 217
Neopeckia coulteri, 71, 181, 183
Neutralizing acid treated soils, 92
Nitric acid for damping-off, 89
NORTON, J. B. S., Hosts of brown-rot Sclerotinia (abstract), 398; Loss from mosaic disease of tomato (abstract), 398; Resistance to Cladosporium fulvum in tomato varieties (abstract), 398
Nursery soils, damping-off in, 89
Nyssa sylvatica, 186

Oak, 75; leaf spot, 396; little-known disease, 49; Polyporus on, 273
Oats, 411; nematodes on, 118

O'Gara, P. J., An anthracnose of Asclepias speciosa caused by a new species of Colletotrichum (abstract), 410; a disease of the underground stems of Irish potatoes caused by a new species of Colletotrichum (abstract), 410; A disease of red clover and alsike clover caused by a new species of Colletotrichum (abstract), 410
Okra, Verticillium wilt of, 393; wilt diseases of, 40
Onion, 75
Oospora lactis, 312, 313, 315
Oospores, difficulty in germinating, 55
Oosporoidea lactis, 312, 313, 315
Orange, susceptibility to fungous gummosis, 54
Orange, hardy, canker of, 397
Orchid, 75
Orton, C. R., and Adams, J. F., Notes on Peridermium from Pennsylvania, 23–26; Collar-blight of apple trees in Pennsylvania (abstract), 43
Orton, W. A., Biological basis of international phytopathology, 11; Inspection and certification of potato seed stock (abstract), 39; The fungus genus Verticillium in its relation to plant diseases (abstract), 40; The potato study trip of 1914 (abstract), 412
Osmotic pressure in cell sap of tomato fruits, 366
Overheating of soil, effect on potatoes, 395

Panax quinquefolia, Phytophthora on, 44
Panicum crus-galli, 108, 109, 111; sanguinale, 107, 111; virgatum, 109, 111
Paper pulp, Fusarium from, 75
Paxillus atratomentosus, 276
Peach, 75, 398; nursery disease due to Sphaeropsis, 394; scab, 408, artificial infection, 49, 408; barium sulphide as spray for, 412, controlled by sulphur, 394
Peanut, fruit rot, 397; leaf spot, 397
Pear, 398; blight, 27; blossom blight, 29; brown blotch, 394; rust, 41; stigmonose, 402; twig blight, 28
Pecky cypress, 39
Pectinase, 38
Peltier, Geo. L., Rhizoctonia in America (abstract), 406; and Rees, C. C., A new rust of economic importance on the cultivated snapdragon (abstract), 400
Penicillium, 293, 297, 299, 348; commune, 403; digitatum, 54; expansum, 403; italicum, 54; pinophilum, 403; roseum, 54
Pepper, mosaic of, 42
Peridermium, 23; acicolum, 25, new hosts for, 26; betheli, 25; cerebrum, 7, 8; comptoniae, 2, 4; pyriforme, 23, 24, 25, 26; strobi, 43
Peronospora effusa, 60; parasitica, 388
Peronosporaceae, Rhizophidium as a parasite of, 55–62
Pestalozzia, 67, 297; brevipes, 403; funerea, 67, 68, morphology and life history, 375; funerea typica, 377; guepini, 376, 403; guepini vaccinii, 376; hartigii, 375, 376; palmarum, 376
Phleum pratensis, 22
Phlyctidium pollinis, 56
Pholiota adiposa, 276; destruens, 276
Phomopsis mali, 403
Phoma acicola, 376; cause of Citrus canker, 397; cause of potato rot, 41; fuckelii, 66; minutula, 66; piceina, 66; piceana, 68; on spruce seedlings, 63, 64, 66
Phyllosticta, 396; paviae, perfect stage of, 399
Phytobacter lycopersicum, 348
Phytopathological Society, American, fifth annual meeting, 36; amendment to the constitution, 37; Western American, organization of, 386
Phytopathological literature, announcement, 124
Phytopathology, biological basis of international, 11; international, relation to commerce, 18
Phytophthora, 40, 394; arecae, 387; erythroseptica, 387; on ginseng, 44; infestans, 387, recurrence from infected seed, 54; per cent of cupric sulphate toxic to spores, 138, introduction from South America, 15; omnivora, 74, 77

Phylloxera, 13
Picea, 63, 181, 271; abies, 63, 64, 380; canadensis, 184, 186, 187; engelmanni, 77, 82, 182, 184, 187, 271, 273; excelsa, 82; mariana, 184, 186, 187; parryana, 77, 82, 184, 186, 187; rubens, 63, 69, 184, 186, 187; sitchensis, 184, 187
PIEMEISEL, FRANK J., Some facts in the life history of Ustilago zeae (Beckm.) Unger. (abstract), 411
Pine seedlings, damping-off of, 89–92; soil disinfection for, 398
Pine, white, blister rust, 41, 43
Pink rot, celery, 45
Pinus, 181, 271; albicaulis, 183, 184; aristata, 184; arizonica, 184, 187; attenuata, 184, 186; austriaca, 24; balfouriana, 183; cembroides, 184, 186; chihuahuana, 184, 186; contorta, 25, 183, 184, 187, 408; divaricata, 67, 75, 184, 187, 375; echinata, 23, 24, 184; edulis, 184, 186; excelsa, blister rust on, 42; flexilis, 183, 184, 187; glabra, 184, 186; jeffreyi, 184, 186; lambertiana, 184; laricio, 409; maritina, 24; mayriana, 184, 186; monophylla, 184, 186; montana, 24; monticola, 183, 184, 273, 274; palustris, 184; ponderosa, 24, 67, 74, 75, 77, 79, 82, 83, 184, 187, 375, 409; pungens, 24, 26; resinosa, 82, 184, 187; rigida, 23, 24, 26, 184, 186, 408; sabiniana, 184, 186; strobiformis, 184, 187; strobus, 75, 82, 84, 184, 187, 375, 376, 380; sylvestris, 75, 78, 79, 82, 84, 273, Peridermium on, 23, 24; pollen infested by Chytridium, 56, 57, 61; taeda, 24, 184; virginiana, 24, Cronartium quercus on, 6, Cronartium comptoniae on, 8, Coleosporium inconspicuum on, 9, damage from wind, 9, from ice and snow, 10, Gallowaya pini on, 9, Trametes pini on, 9, unfavorable soil conditions for, 10
Pit, sweet potato, 405
Pithiacystis citrophthora, cause of gum disease, 54
Plant disease survey, 403; object of, 17
Plant diseases of America, literature on, 207–214, 341–344, 388–391, 414–417
Plant pests, introduced, 13, 14, 15
Plasmopara viticola, introduction into France, 13; per cent of cupric sulphate toxic to spores, 138; studies on, 399
Plaster casts, of apples, 113–114
Plectodiscella piri, 407
Plectodiscelleae, 407
Pleospora, 408
Pleurotus serotinus, 276
Plowrightia morbosa, 339
Plum, 398; black knot on, 339, 340; inoculations with Sclerotinia on, 100; Polystictus on, 275; stigmonose of, 402; wilt disease of, 398
Plum, wild, Fomes igniarius on, 339
Plyctidium, 56
Poa, 108; compressa, 411; nemoralis, 411; pratensis, 411, rust inoculation on, 22
Podophyllum, 75
Point rot, tomatoes, 345
Polyembryony, Razoumofskya americana, 385; douglasii, 385
Polypores, descriptive handbooks of, 409
Polyporus adustus, 273; alboluteus, 271; benzoinus, 274, berkeleyi, 273; borealis, 271; caesius, 274; carneus, 186; chioneus, 273; dichrous, 274; frondosus, 273; giganteus, 273; gilvus, 274; picipes, 273; ponderosus, 184; resinosus, 274; schweinitzii, 69, 184, 186, 187; umbellatus, 273; varius, 273
Polystictus aurantiacus, 274; cinnabarinus, 274; hirsutus, 274, 275, 339; versicolor, 274
POOL, VENUS W. and MCKAY, M. B., Puccinia subnitens on the sugar beet, 204–206
Poplar, crown-gall on, 201
Populus, 272, 273, 274, 275, 339; alba, 186, 276; balsamifera, 184; deltoides, 276; fremontii, 186; grandidentata, 184; heterophylla, 186; tremuloides, 184, 185, 275, 276; trichocarpa, 184, 185, 275, 276; wislizeni, 186
Porthetria dispar, introduction from Europe, 14
Potato, 75; bacterial wilt, 277; black leg, 40; curly dwarf, 40; Fusaria on, 40, 43; Fusarium dry rot, 40; Fusarium wilt, 40; late blight of, 54; leaf roll, 40; leak, 306; melters, 306; mushroom

Potato, root rot, 322; new disease of underground stems, 410; Oospora scab, 40; Phoma rot, 41; pink rot, 387; powdery scab, 40; Rhizoctonia, 220; rot caused by Phytophthora arecae 387; scab, use of sulphur for, 396; silver scurf, 40; southern brown rot, 40; spindling sprout disease, 395; study trip of 1914, 412; tubers injured by formaldehyde, 38; Verticillium wilt, 40, 393; wart, 40
Potato diseases, 321, 322
Potato plants, lightning injury, 406
Potato seed stock, inspection and certification, 39
Potassium permanganate, for damping-off, 77, 78, 79
Potassium sulphide, for damping-off, 77
Pourthiaea villosa, 262
Powdery scab, potato, 40
Pox, sweet potato, 405
Protomyces graminicola, 55
Prunus, 274, 339; demissa, 275, 340; emarginata, 340; pennsylvanica, 340; serotina, 184, 185, 275, 398; subcordata, 340
Pseudomonas campestris, 401; tumefaciens, 202
Pseudotsuga douglasii, 375; mucronata, 75; taxifolia, 184, 273, 274, 275, Sclerotinia fuckeliana on, 65
Psilonia apalospora, 107, 110, 112
Psorosis, 54
Ptychogaster, 273
Puccinia antirrhini, 400; asparagi, 14; graminis, 20, 400, 411; graminis tritici, 400; malvacearum, 15; phlei-pratensis, 20; rhamni, 407; subnitens, 204
Pucciniastrum myrtilli, cause of leaf rust of hemlocks, 70
Pumpkin, 75
Pyrenophora, 408
Pyrox, 394
Pyrus arbutifolia, 398; betulifolia, 398; communis, 41, 263, 266, 267, 407; coronaria, 52; malus, 186, 275, 407
Pythium, 74; debaryanum, 77, cause of damping-off of pine seedlings, 89

Quercus, alba, 238, 274; coccinea, 238; digitata, 185; nigra, 185; pagodaefolia, 186; pedunculata, 275; prinus, 44, 238; rubra, 186, 238
Quercus, Cronartium quercus on, 7, 8
Quince, blossom blight, 27; rot, 306; rust, 41, 261, 264

Ramularia macrospora, 403
Rankin, W. H., Sphaeropsis canker of Quercus prinus (abstract), 44; Field studies on the Endothia canker of the chestnut in New York State, 233–259; Thrombotic disease of maple (abstract), 395; see also Stewart, F. C.
Raspberry, anthracnose, perfect stage, 407; black, 75; red, 75
Razoumofskya cryptopoda, 385
Reddick, D., Decay of celery in storage (abstract), 45
Reed, Geo. M., An unusual outbreak of apple blossom blight, 27
Reed, H. S., York spot and York skin-crack (abstract), 405
Rees, C. C., see Peltier, Geo. L.
Rees, H. L., Bitter rot of apples in the Pacific Northwest, 217–219
Resistance, cabbage to yellows, 404; sweet potatoes to soft rot, 310
Rheum palmatum, 142
Rhizidomyces, 59
Rhizoctonia, 40, 74, 77, 405, 411; in America, 406; on egg plant, 38; on potato, 202; solani, 406; violacea, 406
Rhizophidium, 55, 56; pollinis, development and escape of swarm spores, 58, 59, infection experiments, 60, parasite of oospores of Peronosporaceae, 55
Rhizophyton, 56
Rhizopus, 299, 300; nigricans, 51, 306, 307, 308, 309, 310, 313, 314, conditions for fruiting, 311
Rhizopus, spores infected by Rhizophidium, 60
Rhododendron, Pestalozzia blight of, 376
Ribes, 41; nigrum, 41, Cronartium ribicola on, 43
Ring rot, sweet potato, 51, 279, 306, 313; by Trametes pini, 385
Ring scale, by Trametes pini, 385
Root-knot, ginseng, 33; golden seal, 33
Root rot, resistance of tobacco to, 48

Rosa, 398
ROSE, R. C., see STAKMAN, E. C.
Rose, moss, 75; rust, 20
Rosellinia, cause of twig blight of hemlocks, 70–72; quercina, 72; subiculata, 72
ROSENBAUM, JOSEPH, Some points in the life history of Phytophthora on ginseng (abstract), 44; Phytophthora arecae causing a rot of potato tubers, 387; Studies in the genus Phytophthora (abstract), 394
Rot, pocketed, 187, 188
Rubus occidentalis, 398
RUMBOLD, CAROLINE, Some effects on chestnut trees of the injection of chemicals (abstract), 412
Rust, 41; apple, spraying experiments for, 401; blister, 41; diseases of scrub pine, 6–9, of various pines in Pennsylvania, 23–26; new, of importance, 261; snapdragon, 400; timothy, 337
Rye, 411; nematodes on, 118

Salix, 272, 273, 274, 276, 339; discolor, 276; lasiandra, 275, 276
Sambucus glauca, Nectria destructive to, 340
San José scale, fungus parasite of, 217
Sap rot, of conifers, 184; of deciduous trees, 185
Sap rots, 271
Scab, apple, 52; Oospora, 40; potato, use of sulphur for, 396; peach, 49; powdery, potato, 40
Scale, apple, 403
Scale, San José, 412; oyster shell, 412
SCHWARZE, CARL A., Relation of the mosaic of the pepper and the filiform leaf of the tomato to the mosaic of the tobacco (abstract), 42; An unreported fungus on the oak (abstract), 396; see also COOK, MEL T.
Scleropycnis abietina, 64
Sclerospora graminicola, 55, 57, 60
Sclerotinia cinerea, 93, 94, 95, 100; fructigena, 93, 94, 95, 100; fuckeliana, on spruce seedlings, 63, 65; libertiana, cause of celery rot, 45
Sclerotium bataticola, 50, 305, 306, 312; rolfsii, 197
SCOTT, W. M., A promising new fungicide (abstract), 412
Scurf, silver, 40; sweet potato, 405
Secale cereale, 112; rust inoculation on, 22
Seedlings, coniferous, damping-off of, 73–87; pine, injury by fungicides, 91; spruce, blight of, 63–66
Seed selection, in control of stem rot of sweet potato, 302
Seeds, diembryonic in Razoumofskya, 385
Septoria bataticola, cause of leaf spot of sweet potato, 51, 320; parasitica, 64; petroselina, 45
Sequoia sempervirens, 66; washingtoniana, 66
SHAPOVALOV, MICHAEL, Opredielitel gribov, JACZEWSKI, A. A. VON (Review), 119–121
SHEAR, C. L., Life history of Sphaeropsis malorum Berk. (abstract), 48; Bibliographical citations (abstract), 53
SHERBAKOFF, C. D., Fusaria of potatoes (abstract), 43
Silver scurf, potatoes, 40
SINNOTT, E. W. and BAILEY, I. W., Some technical aids for the anatomical study of decaying wood (abstract), 403
Skin-crack, York Imperial apple, 405
Smut, barley, 46; corn, infection experiments, 411
SMITH, ERWIN F., Identity of the American and French mulberry blight, 34
Snapdragon, rust, 400; Verticillium wilt, 217, 393
Snow, damage to scrub pine from, 10
Soft rot, sweet potato, 306; relation of moisture to, 308, odor, 311
Soil, agent in dissemination, stem rot, sweet potato, 301; cabbage sick, 404; disinfection, notes on, 398; influence on damping-off of coniferous seedlings, 83; management, influence on damping-off of coniferous seedlings, 83; relation to blossom-end rot of tomato, 356; unfavorable for scrub pine, 10

Soil rot, sweet potato, 405
Soil stain, sweet potato, 405
Solanum tuberosum, 287, 296, Fusarium species on, 43; melongena, 287, 288, 296, 298
Solidago, 25
Sorbus aucuparia, 262; hybrida, 41, 261; occidentalis, 262; sambucifolia, 41, 264, 267; scopulina, 262; spuria, 261, 264, 267
Sorghum, 108, 109, 111; saccharum, 109, 111
Southern bacterial wilt, 277
Southern brown rot, potato, 40
SPAULDING, PERLEY, Notes on the white pine blister rust (abstract), 41; Notes on Cronartium comptoniae and C. ribicola (abstract), 409; The damping-off of coniferous seedlings, 73–87
Sphaeronema fimbriatum, 50, 279, 305, 318
Sphaeropsis abundans, 45; on chestnut oak, 44; on peach, 394; malorum, 45, 403, biological strains, 45, life history, 48–49; viticola, 48
Sphaerostilbe coccophila, 217
Sphaerostytidium, 56
Sphaerotheca humuli, 400; mors-uvae, 14
Spindling sprout disease, potatoes, 395
Spondylocladium atrovirens, 321
Spores, isolation of single, 115
Spot, York Imperial apple, 405
Spot rot, Jonathan apples, 102–105
Spraying compared with dusting, 44
Spruce, blight of seedlings, 63; diseases, 63–68; Douglas, 65; Engelmann, 187, treated for damping-off, 91; frost injury, 69; heart rot, 69; Norway, 64, twig blight, 67; Polyporus on, 273; twig blight, 67
Squash, 75
STAKMAN, E. C., The relation between Puccinia graminis and host plants immune to its attack (abstract), 400; A preliminary report on the relation of grass rusts to the cereal, rust problem (abstract), 411; and ROSE, R. C., A fruit spot of the Wealthy apple, 333–335
Steirochaete graminicola, 110
Stem blight, potato, 277
Stem rot, Clematis, 39; egg-plant, 279; sweet potato, 279–304
Stereum hirsutum, 272, 275, 339; purpureum, 272
Sterile water, use for catching spores in the field, 51
STEVENS, F. L., Some problems of plant pathology in reference to transportation (abstract), 410
STEWART, F. C., The spindling sprout disease of potatoes (abstract), 395; and GLOYER, W. O., Formaldehyde gas injury to potato tubers (abstract), 38–39; and RANKIN, W. H., Can Cronartium ribicola over-winter on the currant? (abstract), 43
STEWART, V. B., Specific name of the fire blight organism, 32; The perfect stage of Phyllosticta paviae Desm. (abstract), 399
Stigmonose, 402, 403
Strawberry, 398
Stripe disease, barley, hot water treatment of seed, 45; formaldehyde treatment, 45
Strumella coryneoidea, on chestnut, 49; on oak species, 49
STUDHALTER, R. A., see HEALD, F. D.
Stysanus stemonitis, 321
Sugar, effect on blossom-end rot, tomato, 363
Sugar beet, 75, 204
Sulphur, for apple scab, 44; for damping-off, 77, 79, 80; for hop mildew, 400; for peach scab, 394; for potato scab, 396
Sulphuric acid, for damping-off, 77, 78, 79, 80, 81, 82, 89, 90, 91, 92
Sulphurous acid, for damping-off, 80
Sweet fern, rust on, 23
Sweet gale, rust on, 23
Sweet gum, 39
Sweet pea, 75
Sweet potato, 75; black rot, 50, 279, 305, 318; black shank, 318; charcoal rot, 50, 305; Diplodia species on, 47; end rot, 284, 285; Java black rot, 50; leaf spot, 50, new, 320; pit, 405; pox, 405;

Sweet potato, ring rot, 51, 279, 285, 306, 313; scurf, 405; soft rot, 306, 318; soil rot, 317, 405; soil stain, 405; stem rot, 50, 279, 317; storage rot, 299; vine wilt, 317; white rust, 50; wilt, 317
Sweet potatoes, resistance to soft rot, 310
Symbols, use in designating stages of fungi, 216
Syntherisma sanguinale, 111

Tarnished plant bugs, relation to celery decay, 45
TAUBENHAUS, J. J., The non-validity of the genus Lasiodiplodia (abstract), 47; Some recent studies on new or little-known diseases of the sweet potato (abstract), 50, (article), 305–320; Soil stain and pox, two little-known diseases of the sweet potato (abstract), 405
Tea, Pestalozzia blight, 376
Temperature, relation to blossom blight, 30; to fungous diseases, 16; to ascospore expulsion of Endothia parasitica, 52; to infection of cabbage by Fusarium conglutinans, 404
Thielavia basicola, 75; cause of tobacco root rot, 48
Thrombotic disease, maple, 395
Thuja menziesii, 375; occidentalis, 67, 375; plicata, 186, 273, 274
Tilia europaea, 77; ulmifolia, 77
Timber rot, hemlocks, 69
Timothy, rust, 337; inoculations with Puccinia graminis negative, 22
Tobacco, 75; injury by hydrocyanic acid gas, 118; mosaic, 42; resistance to root rot, 48
Tomato, 75; blossom-end rot, 49, 345; filiform leaf, 42; mosaic disease, 398; point rot, 345; resistance to Cladosporium fulvum, 398
Toxin, secreted by Rhizopus, 307
Trametes abietis, 272; piceinus, 272; pini, 6, 9, 69, 186, 272, 385; suaveolens, 273
Transportation, commercial, relation to plant pathology, 410
Traumatisms, relation to blossom-end rot of tomato, 367
Trees, diseases of, 63, 181–188
Trifolium hybridum, 410; pratense, 286, 287, 410
Trichoderma, 403; köningi, 51, 313, 314
Trichothecium, 393
Tripsacum dactyloides, 107, 111
Triticum spelta, 110; vulgare, 21, 111
Tsuga, 271; canadensis, 69, 70, 184, 187, 380; caroliniana, 69, 70; heterophylla, 66, 184, 187, 272, 273, 274, 275; mertensiana, 182, 183, 184
Tupelo gum, 39
Twig blight, apples and pears, 27, 28; hemlock, 70; Norway spruce, 375; spruce, 67
Tylenchus dipsaci, 118, new to America, 45; devastatrix, 45
Typhula muscicola, 407
Tyroglyphus, 394

Uredo nootkatensis, 262, 408
Ustilago zeae, 411

Venturia inaequalis, perithecia in cultures, 52
Vermicularia, 106, 108, 110; affinis, 108; culmigena, 107, 110, 112; graminicola, 108; holci, 107, 110, 112; lolii, 107, 109, 110, 112; melicae, 107, 112; sanguinea, 108, 110
Verticillium, 393, 403; alboatrum, 40, 298, 393; dahliae, 40, 393; on maple roots, 40; on okra, 40; wilt, 40, of snapdragon, 217
Viscum album, 385
Vitis rotundifolia, resistant to black rot, 13; vinifera, susceptible to downy mildew, 13

WAITE, M. B., Stigmonose: a disease of fruits (abstract), 402
WALTON, R. C., The relation of temperature to the expulsion of ascospores of Endothia parasitica (abstract), 52
Water, agent in dissemination of stem rot, sweet potato, 301
Watermelon, 75

WEIR, JAMES R., Notes on wood destroying fungi which grow on both coniferous and deciduous trees, I, 271–276; An unusual host of Fomes fomentarius, 339; Cankers of Plowrightia morbosa in their relation to other fungi, 339; The cavities in the rot of Trametes pini as a home for hymenopterous insects, 385; The polyembryony of Razoumofskya species, 385
WENNER, JOHN J., A contribution to the morphology and life history of Pestalozzia funerea, 375–384
Wheat, 21, 22, 411; rust, 400
White pine, 75; blister rust of, 41
White rust, sweet potato, 51
Wild crab, scab of, 52
WILSON, GUY WEST, The identity of the anthracnoses of the grasses in the United States, 106–112; see also COOK, MEL T.
Wilt, bacterial of potatoes, 277; Fusarium, 40; plum, 398; Verticillium, 40, 393
Wind, agent in dissemination, stem rot sweet potato, 301, chestnut blight fungus, 51; damage to scrub pine from, 9
WINSTON, J. R., see FULTON, H. R.
Winter temperature, possible relation to Missouri outbreak of apple blossom blight, 30
Witches' brooms, on cedars, 268
WOLF, FREDERICK A., Fruit rots of egg plants (abstract), 38; Leaf spot and some fruit rots of the peanut (abstract), 397
Wood-destroying fungi, 271

Xanthium, 393

Yellows, cabbage, 404

Zea mays, 106, 107, 111
Zinc chloride, for damping-off, 89, 90, 92

CONTENTS OF VOLUME IV

No. 1. February

Pierre-Marie-Alexis Millardet (with portrait). B. T. Galloway 1
Notes on diseases of trees in the Southern Appalachians II. Arthur H. Graves 5
The biological basis of international phytopathology. W. A. Orton 11
Investigations of timothy rust in North Dakota during 1913. W. H. Mercer .. 20
Notes on Peridermium from Pennsylvania. C. R. Orton and J. F. Adams 23
An unusual outbreak of apple blossom blight. George M. Reed 27
Phytopathological notes 31
Report of the Fifth Annual Meeting of the American Phytopathological Society 36

No. 2. April

A species of Rhizophidium parasitic on the oospores of various Peronosporaceae. I. E. Melhus 55
Notes on diseases of trees in the southern Appalachians III. Arthur H. Graves 63
The damping-off of coniferous seedlings. Perley Spaulding 73
Preliminary tests of disinfectants in controlling damping-off in various nursery soils. Carl Hartley and Theodore C. Merrill 89
A study of the brown-rot fungus in the vicinity of Champaign and Urbana, Illinois. J. L. Conel 93
The Jonathan spot rot. Mel T. Cook and G. W. Martin 102
The identity of the anthracnose of grasses in the United States. Guy West Wilson 106
The plaster cast apple specimen. Leo E. Melchers 113
A method of picking up single spores. C. W. Edgerton 115
Phytopathological notes 118
Reviews 119

No. 3. June

Bordeaux Mixture: I. Physico-chemical studies. O. Butler 125
Notes on some diseases of trees in our national forests. IV. George Grant Hedgecock 181
Cladosporium disease of Ampelopsis tricuspidatum. Mel T. Cook and Guy West Wilson 189
Pathological histology of the Endothia canker of chestnut. W. E. Keefer 191
Notes on economic fungi. Mel T. Cook 201
Puccinia subnitens on the sugar beet. Venus W. Pool and M. B. McKay 204
Literature on plant diseases 207
Phytopathological notes 215

Contents

No. 4. August

A bacterial disease of Erodium and Pelargonium. I. M. Lewis 221
Field studies in the Endothia canker of chestnut in New York state. W. H. Rankin 233
A new pomaceous rust of economic importance, Gymnosporangium blasdaleanum. H. S. Jackson 261
Notes on wood destroying fungi which grow on both coniferous and deciduous trees. James R. Weir 271
The southern bacterial wilt in New Jersey. Mel T. Cook 277
The stem-rot of the sweet potato (Ipomoea batatas). L. L. Harter and Ethel C. Field 279
Recent studies of some new or little known diseases of the sweet potato. J. J. Taubenhaus 305
Notes on potato diseases from the northwest. F. D. Bailey 321
Preliminary notes on the cultivation of the plant-parasitic nematode, Heterodera radicicola. L. P. Byars 323
A disease involving the dropping of cotton bolls. J. Lee Hewitt 327
A fruit spot of the Wealthy apple. E. C. Stakman and R. C. Rose 333
Phytopathological notes 337
Literature on American plant diseases 341

No. 5. October

Blossom-end rot of tomatoes. Charles Brooks 345
A contribution to the morphology and life history of Pestalozzia funerea Desm. John J. Wenner 375
Phytopathological notes 385
Literature on American plant diseases 388

No. 6. December

Abstracts of papers to be presented at the sixth annual meeting of the American Phytopathological Society at Philadelphia, Pa., December 29, 1914, to January 1, 1915 393
Literature on American plant diseases 414

1838-1902

PHYTOPATHOLOGY

VOLUME IV NUMBER 1

FEBRUARY, 1914

PIERRE-MARIE-ALEXIS MILLARDET

(1838–1902)

B. T. GALLOWAY

WITH PORTRAIT, PLATE I

Millardet was born December 13, 1838, at Montmérey-la-ville. He came from an intellectual and honorable family, his father being a notary public. He has left a son behind him who is professor of Romance languages in the University of Montpellier.

Primary instruction was given Millardet by his parents, and his first Latin by the Curate of Dammartin. In 1850 he entered the Jesuit college at Dôle, finishing his classic studies at the Catholic school of Besançon. In 1854 he began the study of medicine at Paris at the suggestion of his uncle, Dr. Millardet, but dominated by his inborn love for the natural sciences, he frequented the research laboratories more willingly than the clinics or the dissecting rooms, and soon forsook the medical school for the Faculté des Sciences. On the presentation of Roze and Montagne he was made a member of the Société Botanique de France (1861), while yet a student, and his first work in botany dates from that period, being done in collaboration with Montagne, the result of which was the description of a collection of tropical algæ from the island of Réunion.

Encouraged by his first success in botany, Millardet renounced the situation which his uncle, the doctor, had reserved for him in his office and obtained permission from his mother to go to Germany for university study, and to perfect himself in the German language.

In Germany he studied at Heidelberg under Hofmeister, and at Freiburg under De Bary, from each of whom he received a tremendous stimulus. There also he made the acquaintance of Solms-Laubach, Gregor Kraus, Strasburger, Askenasy, Magnus and others who were fellow students and by whom he was recognized not only as a keen student but also as a good fellow. They specially envied his ability to concentrate on problems and his facile pencil which enabled him to illustrate whatever he studied. The illustrations in the Montagne-Millardet paper on algae show what

he could do, and anyone today might be proud to have made them. Mention should also be made of the drawings in his paper on the anatomy and development of the woody bodies in Yucca and Dracaena. He always retained a very kindly feeling for his German professors, especially De Bary, and had great admiration for the best features of the German university system which he desired earnestly to have introduced into France, particularly the laboratory method of instruction open to every student. This breadth and perspicacity of judgment is shown very clearly by a most interesting brief paper of his on the German university system, written during a visit to Heidelberg in 1869, i.e., after the close of his university career.

On his return to France, Millardet received his degrees of Doctor of Medicine and Doctor of Sciences, and was then appointed assistant professor of botany at the Faculté des Sciences at Strasburg (1869). His scientific activity was interrupted by the war of 1870, in which he took part as military doctor. After the war, wishing to remain in the east, he took charge of the course at the Faculté des Sciences at Nancy (1872), but in 1876 became professor of botany at Bordeaux, where he remained until his health, which was delicate, obliged him to retire in 1899.

During this thirty years of collegiate work Millardet published more than one hundred papers and acquired an international reputation as a student of diseases of the vine. His papers fall readily into three main types, viz., (1) researches on the morphology, physiology and systematic relations of various plants; (2) studies of Phylloxera and the hybridization of vines to secure varieties resistant to its ravages, using American vines previously shown by Planchon and others to be very resistant to this pest, which was then destroying the vineyards of France; (3) similar studies on the vine mildew (*Plasmopara viticola*), discovering that it could be controlled by the use of copper sprays.

His earliest works were pure researches devoted to varied subjects. He studied successfully the anatomy and growth of the stem of Yucca and of Dracaena; the development in thickness of the cellular membranes; the coloring matter of the Phycochromaceae (begun in collaboration with Kraus), of the Diatoms, and of the Fucoideae. While at Nancy he published his Mémoire on the new coloring matter (solanorubine) which he had found in the tomato. At Freiburg-en-Breisgau he discovered a little epiphytic alga, which he named Phycopeltis. With Montagne, as already mentioned, he published a work on the Algae of the Réunion. A study of the cause of the movements of the sensitive plant constituted his thesis for the degree of doctor of medicine. For the degree of doctor of science he presented a thesis on the prothallium of vascular cryptogams.

On his arrival at Bordeaux he received a commission to determine the

comparative resistance of various American vines to the attacks of Phylloxera. From that time on he devoted his entire energies to research on methods of reconstituting the destroyed vineyards. By hybridization he secured stock resistant to the Phylloxera and adapted to the nature of the soil, and cleared up many questionable points as to the development of the disease.

His last work consisted chiefly of researches on the mildew, and the means of combating it, has probably rendered his name more popular than his ampelographic work and his pure researches. In 1882 Millardet published a detailed description of the disease, pointing out the circumstances which could favor or retard it, and in the same year he began experiments which confirmed his belief in the efficiency of the copper salts which he had seen used in Médoc on vines along the highway to prevent pillage of the grapes. In speaking of his treatment of mildew by the salts of copper, Millardet says:

"The observation which led me to conceive the principal of the treatment dates several years back. I was studying the development of the summer spores or conidia of Peronospora, when I ascertained that these reproductive bodies would never develop in the water of my well, while sown in city water, rain water or dew, or distilled water, they were not long in completing their evolution, producing zoospores. The explanation of this fact escaped me for a long time."

After his observation of the good effect of the copper salts at Médoc, and knowing that the water in his well was lifted by means of a copper pump, he made analysis of the water in collaboration with M. Gayon, which showed that it contained more than ten times as much copper as is necessary to kill the reproductive bodies of Plasmopara.

Through the researches of Millardet and his colleagues and collaborators, both of these destructive diseases were overcome and the waning wine industry of France resuscitated. As we look back upon what has been done in France, the undertaking appears to have been herculean. Practically all vines in France are now grown on American roots resistant to the Phylloxera, and while the mildew and other vine diseases still occur destructively in parts of France, they are no longer feared by the country as a whole, owing to the wide dissemination of fungicidal sprays which are still largely composed of the substances first recommended by Millardet.

Soon after the appearance of Millardet's first paper on copper fungicides for the grape mildew they were tried out successfully on this and other diseases in the United States and in other parts of the world, and are still universally used for a great variety of plant diseases, although since Millardet's time certain other fungicides, e.g., the lime-sulphur, have been found better adapted to the treatment of certain diseases.

Notwithstanding this, copper is still our chief dependence in the treatment of plant diseases.

Millardet received in 1893 the Morogues prize for his work on the mildew of the vine, and from all sections, from scientific societies, academies, Governments even, he received numerous testimonials of gratitude and of admiration. His name is still held in honor in France, as shown by the frequent reference to him in literature, and also by the fact that the vine-growers of France propose the coming season to erect a life-size bronze figure of him in Bordeaux.

Millardet was successively the brilliant collegian, distinguished investigator, and eminent savant. As a teacher, one of his pupils says of him: "The lesson of the master, always clear and concise accompanied by numerous sketches of impeccable clearness, replaced henceforth the long and confused developments of the classic treatises then in use. . . . I have seen him abandon his personal studies in order to assist us in our practical work, or to return to each of us our written compositions carefully annotated, taking up the mistakes made, and encouraging our work, showing us thus the interest which he bore for us. This solicitude which he lavished upon his pupils did not stop with the term of their studies. He put willingly at the disposition of the young graduate the books and the numerous publications of his library, the plants of his garden, and showed himself always disposed to serve as intermediary with the scientists of the entire world who carried on with him uninterrupted correspondence."

The photograph accompanying this sketch is one which is preferred by his son as being on the whole the best likeness of his father.

NOTES ON DISEASES OF TREES IN THE SOUTHERN APPALACHIANS II

ARTHUR H. GRAVES

WITH PLATE II AND ONE FIGURE IN THE TEXT

DISEASES OF THE SCRUB PINE (*Pinus virginiana* Mill).

As stated in the first paper,[1] this species is one of the four to which the writer paid especial attention in the general survey of diseases of trees in the southern Appalachians. The plan of the present paper will accordingly differ somewhat from that of the previous one in that, in addition to the writer's observations, it attempts to present a comprehensive outline of the pathological data concerning this species.

The scrub pine is one of the typical trees of the southern Appalachians, ranging from southern New York to northern Alabama and southern Indiana. While in the northern part of its range it is found near the coast, toward the south it becomes more and more restricted to the higher land, and the mountains of western North and South Carolina, northern Georgia, and Alabama form the southern limit of the species.

From an economic standpoint the tree is of importance because of its ability to grow rapidly in poor soil where few, if any, other species will grow. Although principally used for fuel, the trees are often large enough to be profitably cut into lumber. They are also used extensively for charcoal, as well as for excelsior, paper pulp, railroad ties, piling, mine props, etc.[2]

The scrub pine was carefully studied from a pathological standpoint in almost every state in which it occurs naturally, and was observed in a great variety of sites and soils, the main object of the work being to determine, if possible, the general condition of the species as regards freedom from or liability to disease or injury.

Before noting more particularly the various diseases and injuries to which the species is prone, it may perhaps be well first of all to briefly summarize the investigations.

[1] Graves, Arthur H. Notes on diseases of trees in the southern Appalachians I. Phytopathology **3** : 129–139. 1913.

[2] Sterrett, W. D. Scrub Pine (Pinus virginiana). U. S. Dept. Agr., Forest Service Bul. 94 : 1–27, figs. 1–2. July, 1911.

The species was found to be subject to the attack of a variety of insects, which cause locally considerable damage. As regards fungous diseases, it suffers most of all from a trouble which has been named the "burl disease," caused by *Cronartium Quercus* (Brond.) Schröt. It is also occasionally affected with "heart rot" caused by *Trametes Pini* (Brot.) Fr., and to a lesser degree by a rust, *Gallowaya Pini* (Gall.) Arth. which attacks the needles, causing a "leaf cast." A second disease of the needles, caused by *Coleosporium inconspicuum* Long,[3] has recently been found, but this is apparently rather rare. Among injuries due to inorganic causes, the most important is a tendency to windthrow under certain conditions, while damage from ice and snow sometimes occurs.

On the other hand, to offset the loss from such causes, the tree shows a remarkable adaptability for growing in a great variety of sites and soils, especially those of a sterile character, where it has to undergo little or no contest with other species for the possession of the soil. In addition to this advantageous trait, it exhibits during its earlier years an unusually vigorous growth, developing a great number of healthy leaders, and in many cases producing two height growths in a year.

It is believed that the advantages accruing from the last-mentioned characteristics far outweigh the damage which the species receives from fungi, insects, and other causes. In the opinion of the writer, therefore, the species considered as a whole may be looked upon as being, in general, in a thrifty condition.

In the following paragraphs the more important fungous diseases and injuries to which the species is liable are briefly outlined.

THE BURL DISEASE. *Cronartium Quercus* (Brond.) Schröt.

This is caused by a rust, first described in its Peridermium stage byPeck,[4] which induces on this host as well as on several other species of pines,[5, 7] a well-known disease characterized by gall-like swellings or "burls" on the branches or on the main trunk.

The disease was found by the writer to occur very commonly on scrub pine in Maryland, Virginia, North Carolina, and Georgia. It is also recorded on this host in the vicinity of Washington, D. C.,[6] in Pennsylvania,[7]

[3] Long, W. H. Two new species of rusts. Mycologia **4** : 282–284. 1913.

[4] Peck, C. H. Descriptions of new species of fungi. Bull. Buffalo Soc. Nat. Sci. **1** : 68. 1873.

[5] Arthur, J. C. and Kern, F. D. North American species of Peridermium. Bull. Torrey Bot. Club **33** : 403–438. 1906.

[6] Shear, C. L. Peridermium cerebrum Peck and Cronartium Quercuum (Berk.) Jour. Myc. **12** : 89–92. 1906.

[7] Arthur, J. C. Uredinales. North American Flora. $\mathbf{7}^2$: 122. 1907.

and in Alabama.[8] It is probable that it occurs on the scrub pine throughout its entire range.

A single tree may have only one, or a large number of burls variously scattered on the trunk and branches. When appearing on the branches, they assume a more or less spherical shape, usually varying from one-quarter of an inch to 4 inches in diameter, although much larger ones are occasionally found (pl. II, fig. 1). In the earlier stages the swelling is usually on one side, but as the burl increases in size it may extend completely around the branch. If occurring on the main trunk, a burl may take up only a portion of its circumference, particularly on large trees, and often it does not project out far, appearing thus as a slightly raised protuberance occupying a more or less circular area on the trunk. The writer has seen specimens of this latter type occupying a space of a diameter of 10 inches on the trunk of a large scrub pine. After the burl is once started, whether on the branch or trunk, it increases in size from year to year, provided the part of the tree where it grows continues to live.

Shear[9] was the first to connect the rust causing this disease, then known as *Peridermium Cerebrum* Peck, with a Cronartium on the leaves of oaks, i.e., *Cronartium Quercus* (Brond.) Schröt. From data given by Farlow and Seymour,[10] Shear, and Arthur,[11] this Cronartium has been found in nature on the following species of Quercus: *agrifolia, alba, coccinea, digitata, macrocarpa, marylandica, minor, nana, nigra, Phellos, prinoides, Prinus, rubra, velutina,* and *virginiana.*

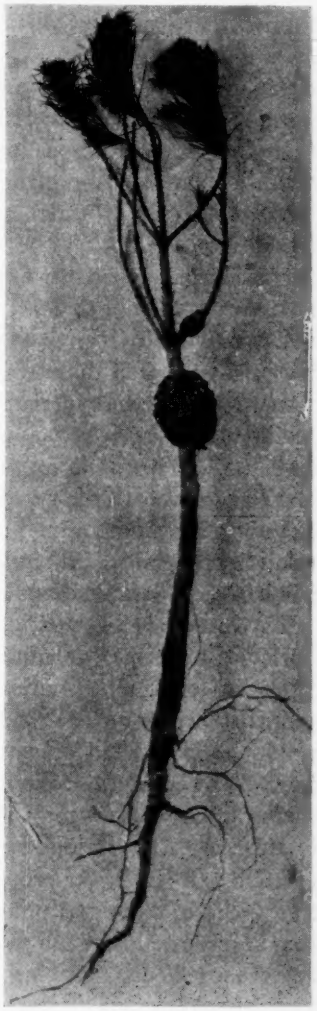


FIG. 1. Burls caused by Cronartium Quercus on young trees of Pinus virginiana. Supplied by the Laboratory of Forest Pathology, U. S. Department of Agriculture.

[8] Mohr, Charles. Plant life of Alabama. Cont. from U. S. Nat. Herb. **6** : 192. 1901.

[9] Shear, C. L. Loc. cit., p. 92.

[10] Farlow, W. G., and Seymour, A. B. A provisional host-index of the fungi of the United States. Pp. 118–122. 1888–1891.

[11] Arthur, J. C. Loc. cit.

Subsequently Arthur[12] confirmed Shear's results. Using aeciospores from *Peridermium Cerebrum* on *Pinus virginiana*, he produced the uredinia of *Cronartium Quercus* on leaves of *Quercus velutina*. Later, Hedgcock[13, 14] completed the life cycle by successfully inoculating the pine with teliospores from oak leaves, typical burls being formed. Moreover, by Hedgcock's work some additions were made to the list of eastern oaks known to be alternate hosts, while a number of western species of oaks, as well as *Castanopsis chrysophylla* (Hook.) A. DC., were successfully infected.

In the pine, the mycelium remains in active condition in the cambium region of the burl for many years, the length of this period depending on the vitality of the branch or trunk in which it may be growing. According to Von Schrenk,[15] the stimulus exerted by the fungus results in the formation of an excessive amount of soft, pulpy wood in the burl, which increases from year to year.

Where young trees or young branches are affected, as in text-figure 1 the result is often disastrous. The trunk or branches will gradually become dwarfed, and in particular the part above the burl will be much smaller than the part below it. The infected branches or the entire tree may die. Where the burls occur on older tree trunks, the effect is less marked on the tree as a whole. Nevertheless, by the occasional death of young seedlings, and through the inevitable diminution of the annual wood increment of all individuals attacked, the disease causes on the whole a considerable loss.

The most feasible method for control is to select all trees in which the burls are present or forming, and fell them during improvement thinnings. Since, as long as the burls are in a living condition, a new crop of aeciospores is produced each spring, the most opportune time for such work would be in the fall or winter, in order to prevent a new crop of spores from being shed the following spring. Moreover, it is evident that the spread of the disease may be prevented by removing the alternate hosts—in this case, the various species of oaks which are susceptible. The advisability of the latter procedure, however, depends of course on the relative value of oaks and pines in any given locality. In this connection it should be stated that the pine-sweetfern rust, *Cronartium Comptoniae* Arth. has been collected on this host by Ellis (N. A. F. 1021, 1882). Like the

[12] Arthur, J. C. Cronartium Quercus (Brond.) Schröt. Jour. Myc. **13** : 194. 1907.

[13] Hedgcock, G. G. Notes on some diseases of trees in our national forests. Science, n. ser. **31** : 751. 1910.

[14] Hedgcock, G. G. Notes on Peridermium Cerebrum Peck, and Peridermium Harknessii Moore. Phytopathology **1** : 131–132. 1911.

[15] Von Schrenk, Hermann. Unpublished data in the possession of the U. S. Forest Service.

preceding species, it is perennial in the trunk or branches of the pine, causing usually slight elongated swellings. In this case Clinton[16] was the one who connected the stage on the sweet-fern (*Myrica asplenifolia* L.) with that on the pine.

HEART ROT. *Trametes Pini* (Brot.) Fr.

Specimens of the fruiting bodies of the fungus causing this destructive disease were found on the trunks of living scrub pines in two localities, i.e., near Tallulah Falls, Georgia, and in the vicinity of Leonardtown, Maryland. In both of these regions the scrub pine was abundant.

LEAF CAST. *Gallowaya Pini* (Gall.) Arth.

This disease, which was not seen by the writer, is caused by a species of rust and is abundant on the leaves of scrub pine in the District of Columbia, Virginia, and Maryland.[17] It has also been collected by Galloway in North Carolina and Tennessee. As far as is known, the scrub pine is the only host, and, as Galloway has intimated, the disease may be looked for throughout its range.

The fungus is noteworthy in that aecia and uredinia are wanting. Telia complete their development on the old needles in May or June, and the resulting sporidia infect the young needles which are just beginning their growth at this time. This rust, accordingly, requires only one host for the completion of its life-cycle.

Coleosporium inconspicuum Long

Long[18] has recently described this second species of rust attacking leaves of the scrub pine. By infection experiments he has ascertained that the alternate host is *Coreopsis verticillata* L.[19] Apparently this fungus is rare, having been collected by Miss Charles and Long in only one locality in Maryland.

DAMAGE FROM WIND

The scrub pine often grows on light, sandy soils, or on clayey soils with an admixture of sand. When this is the case, its comparatively shallow root system, although it extends laterally into the soil for a considerable

[16] Clinton, G. P. Notes on certain rusts with special reference to their Peridermial stages. Science **27** : 340. 1908.

[17] Galloway, B. T. A rust and leaf casting of pine leaves. Bot. Gaz. **32** : 433–453, pl. 2, fig. 3. 1896.

[18] Long, W. H. Two new species of rusts. Mycologia **4** : 282–284. 1912.

[19] Long, W. H. and Hedgcock, G. G. Notes on cultures of three species of Peridermium. Phytopathology **3** : 250–251. 1913.

distance, does not fix it in the ground with any considerable degree of firmness. Under these conditions, therefore, the trees are more or less susceptible to windthrow.

Great numbers of scrub pines throughout Maryland were overthrown by the gales accompanying the violent storm of March 3–4, 1909. Both sleet and snow fell during this storm, and their weight was probably an important factor in the destruction of the trees. In many places in Maryland the havoc wrought by this storm is still apparent (pl. II, fig. 2). A large proportion of the trees were killed outright, by being entirely uprooted; others were found to be still living in an oblique position. It is moreover noteworthy that, compared with other species, the scrub pine was the chief sufferer in this storm.

DAMAGE FROM ICE AND SNOW

In Maryland and Virginia many large scrub pines were observed by the writer to have the young leaders broken off at their tops for a short distance, perhaps 2 or 3 feet. On examination these showed no evidence of fungous disease or insect injury, and the most natural conclusion is that the damage here is caused by ice and snow. Such injury, of course, opens up vulnerable spots in the trees where insects or fungi may enter later.

As already mentioned, the weight of ice and snow may also be a factor of considerable importance in the overthrow of the whole tree.

UNFAVORABLE SOIL CONDITIONS

Although the scrub pine is not at all particular as regards soil, yet on some sites where the soil is extremely poor and dry, the trees are often apparently affected by these conditions, exhibiting a stunted height growth and very short leaves. It is possible, indeed, that this condition is due to drought alone.

YALE UNIVERSITY
NEW HAVEN, CONN.

EXPLANATION OF PLATE II

Photographs supplied through the courtesy of the Laboratory of Forest Pathology and the Forest Service, U. S. Department of Agriculture.

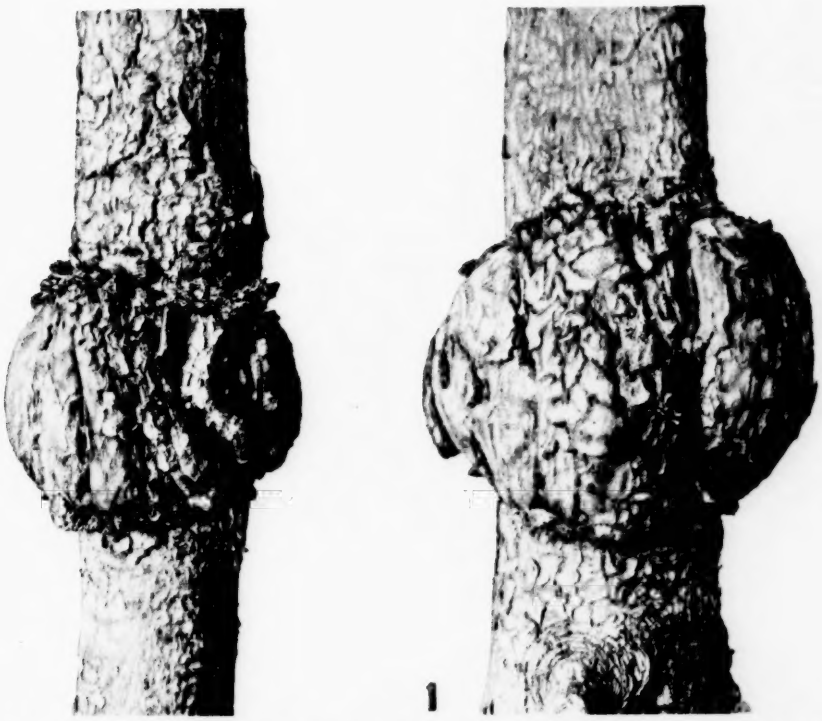
FIG. 1. Burls caused by Cronartium Quercus on Pinus virginiana.

FIG. 2. Windthrow of Pinus virginiana, near Leonardtown, Maryland.

NOTES ON DISEASES OF TREES IN THE SOUTHERN APPALACHIANS II

PLATE II

ARTHUR H. GRAVES



1. BURL DISEASE OF SCRUB PINE
2. WINDTHRAW OF SCRUB PINE

THE BIOLOGICAL BASIS OF INTERNATIONAL PHYTOPATHOLOGY

W. A. Orton

The movement for international concerted action for the control of plant diseases and insect pests, which has been gaining headway for several years, has now reached a point where it appears highly probable that the principal nations of the world will coöperate to this end, through the International Institute of Agriculture at Rome, and that following the International Commission on Phytopathology which will meet in Rome on February 24, 1914, there will be a plan presented to the several governments for the organization of a Permanent Commission on Phytopathology in connection with the Institute, or at least providing for regular biennial conferences of phytopathologists of all nations.

There are the best of reasons to hope that these conferences will result in a plan for improved and more uniform legislation for phytopathological inspection and control in the several countries, and where needed, for international agreements on these matters. The scientific investigation of phytopathological problems will also receive much aid and stimulus from this international entente.

It is in view of this new and hopeful situation that the suggestions embodied in this paper are made, to contribute toward the establishment of those fundamental principles on which successful international action must be based.

THE BIOLOGICAL BASIS OF DISEASE CONTROL

International phytopathology deals primarily with communicable diseases of plants, caused by parasitic fungi, bacteria, etc., and with insects and other members of the animal kingdom injurious to plants. The successful control of these pests, whether by local organizations or by international action, must be based on biological principles, on the known facts of the life history of the organism in question, its origin, method of attack, manner of reproduction, its host plants and natural enemies, the influence of temperature, humidity and other environmental factors on its growth and development, etc. In short, the whole problem of parasitism is involved. Not only must our scientific investigations follow these lines, but the enactment of laws for the control of plant pests by means of quarantines, inspections or other means must be based on the same biological foundation in order to be justifiable and in order to succeed.

The present widespread demand for international coöperation for the control of plant diseases has come about through the general appreciation of "the fact that plant diseases do not recognize national limits or geographical boundaries," but are spreading from land to land in increasing numbers, and causing such lamentable losses to agriculture as to constitute a serious economic problem and a menace to prosperity.

Legislative means for limiting the spread of plant pests have been imperfect and relatively ineffective because not uniform in adjacent countries and not based on sufficient knowledge.

From the scientific standpoint, although plant pathology has grown apace during recent years and stations for the study of plant diseases and insect pests have multiplied, the investigators have encountered many knotty problems that require concerted attack from different viewpoints or comparisons of observations made under varying environments, and now seek a more efficient means of international progress than the exchange of publications has afforded in the past.

That some international action for the restriction of plant diseases is advisable, nearly all are agreed, but when we examine the plans and method suggested from various sources, we encounter as many prescriptions as there are doctors and we are led to the conclusion that international measures have not always been differentiated from those of purely local application.

What then, are the international problems of phytopathology? And what the biological laws that must govern our efforts to solve these problems? Let us recall first the rôle of parasitism in nature, and bring to mind the complex structure of the organic world, wherein all species of plants or animals are more or less dependent on other species, and all contribute toward the maintenance of others, a relationship that is everchanging, yet always tending to maintain an equilibrium between the established fauna and flora in any given region.

Parasitism exists everywhere in nature and in an infinite number of types, ranging in the case of fungi, for example, from those occasional or wound parasites that have barely departed from the saprophytic mode of nutrition up to those in which the adaptive relation between host and parasite has reached the highest stage of development. The course of evolution leads to a point where parasite and host exist in a state of relative equilibrium, marked by a reduction of toxin formation on the part of the parasite and its ability to live on its host with a minimum of injury until reproduction is accomplished. The host species may also possess a decided resistance to infection by parasites with which it has long been associated. Similarly, among insects, there exist in nature parasites and hyperparasites of predatory species which tend to restrict their increase.

Such is the balance maintained by nature when not disturbed by man. The range of plant parasites is generally limited by oceans or other barriers which limit the range of their hosts. We have to deal with an *intercontinental* problem. The history of plant pathology shows that the larger number of the most serious diseases and the most destructive insects have come originally from other continents. Parasitic fungi thus transferred to a new environment have found species of plants closely related to their original host, but lacking the resistance or endurance possessed by that host. The newly introduced parasite spreads under such conditions with a rapidity and destructiveness never observed in its original habitat. The same principle is exemplified in numerous instances where insects taken by chance to another continent have left behind them their numerous natural parasites, and, freed from this restraint, have multiplied and become exceedingly destructive.

Europe has received from North America some of its worst pests. The phylloxera was a native parasite of the wild grapes of the eastern United States, which are highly resistant to it. Not so the *Vitis vinifera* of Europe and the vineyards there suffered incalculable losses before the immunity developed by the American vine through long centuries of association with the insect was utilized and resistant stocks and hybrids brought into general use. Later, the black-rot (*Guignardia Bidwellii* (Ell.) Viala & Ravaz) was introduced into France and ravaged the European vineyards. This also is an American parasite and there exist in the United States species, like *Vitis rotundifolia* which are highly resistant to it. The downy mildew (*Plasmopara viticola* (B. & C.) Berl. & De Toni) was also taken to France about 1878 with vines imported from America. *Vitis vinifera* proved very susceptible and the disease spread with great rapidity, destroying many vineyards. This fungus is common but only moderately destructive on our wild American grapes.

The history of these grape diseases is of the highest significance to the student of international phytopathology. If there had been available fifty years ago the knowledge we now possess of phylloxera, black-rot, and mildew, these need never have spread to Europe. For nearly three hundred years, beginning almost with the first European colonies established in the New World, there were a succession of fruitless efforts to cultivate *Vitis vinifera* in America. That the climate and soil were adapted to grapes was evidenced by the profusion of native species of Vitis found in the forests and the abundant harvests of wild grapes they bore, yet the colonists who planted European vines saw them perish with a fatal sickness. Each new attempt to cultivate the vine in America met with failure and disappointment, until there began to appear improved varieties of American parentage, the Catawba, the Herbemont, the Concord, and others, and the

conviction spread that American viticulture must be founded on the native varieties which alone possess the quality of resistance to phylloxera, black-rot and mildew. How unfortunate that it was not realized earlier why the European grapes failed in America and the danger of introducing these parasites in Europe guarded against.

A still more recent example of this interchange of parasites is afforded by the spread in Europe of the American gooseberry mildew (*Sphaerotheca Mors-uvae* (Schw.) B. & C.). Here there was abundant warning. The large-fruited European gooseberries have been introduced and tried in the United States thousands of times, but their culture has never succeeded because of this mildew, which spreads to them from the native gooseberries. The latter are very resistant to the attacks of *Sphaerotheca Mors-uvae*, while the European varieties are very susceptible. The disease appeared in Ireland about 1900 and now occurs in so many countries of northern Europe that it seems unlikely that it can ever be exterminated. Quarantines against this disease are now too late. The application of the principles of international phytopathology should bring about a world-wide search for resistant stocks, the best of which will be found where the mildew is endemic, and these should be hybridized with European gooseberries until the edible quality and size of fruit of the latter is combined with the disease resistance of the imported stock.

Europe has sent America in return many serious pests. The gypsy moth (*Porthetria dispar*) and the brown-tail moth (*Euproctis chrysorrhoea*) have spread in New England to an extent never known in Europe. They have repeatedly defoliated and killed valuable street and forest trees and caused losses of millions of dollars. Their extermination is no longer possible. The only hope is that their natural parasites, which have been introduced in large numbers, will eventually bring them to an equilibrium, but it seems probable that in the meantime radical changes will take place in the forest vegetation of the afflicted district, through the replacement of those species of trees which are the favorite food plants of the insect by less palatable sorts.

Asparagus rust (*Puccinia asparagi* D. C.), although known in Europe for a century, was not observed in the United States until about 1896, when it began to spread rapidly in New Jersey and adjacent states. By 1901 it had reached the Pacific Coast, causing everywhere serious injury to asparagus cultures. The more susceptible varieties have been practically driven out of cultivation. The method of control of asparagus rust strongly supports the argument of this paper. The U. S. Department of Agriculture searched Europe for all obtainable varieties and species of asparagus, and began breeding for rust resistance. Promising plants were discovered in an English strain and crosses between these have already yielded resistant varieties.

South America has burdened both Europe and North America with serious pests and has others as bad or worse in reserve for the future. The hollyhock rust (*Puccinia malvacearum* Mont.) probably came from Chile to Europe in the seventies, and reached the United States soon after. It has been a serious handicap to the culture of this cherished ornamental.

Phytophthora infestans (Mont.) De By., is the worst enemy of the potato and one of the most destructive plant parasites of the world. It is believed that it came from South America, where it may be endemic on some wild potato. It will be important to know whether any South American potatoes have developed resistance to Phytophthora. Explorations and tests to determine this are being made by the U. S. Department of Agriculture.

It is very important to know the fungi and insects of South America before any more are introduced into North America and Europe. We shall soon find ourselves in much closer intercourse with these countries as a consequence of the opening of the Panama Canal, whereby the possibilities of exchanges of plant parasites will be greatly increased. No plea is being made for restrictions of commerce, but for opportunities to investigate and discover the facts as to these as yet unknown perils. Such investigations, if made on an international basis, would benefit the South American countries greatly, since they would add to their knowledge of home conditions many points concerning parasites of the northern hemisphere against which they should safeguard themselves.

From China there has come to the United States one of our most destructive scale insects, *Aspidiotus perniciosus*, the San José scale, a parasite of many fruit and ornamental trees and shrubs and one that has caused enormous losses to horticulture, estimated at $5,000,000 per annum. For the control of it there is spent in the United States every year another $5,000,000.

More spectacular still is the chestnut bark disease, *Endothia parasitica* (Murr.) A. & A., which first appeared near the city of New York about 1904. This fungus girdles and kills the American chestnut, *Castanea dentata*, very quickly, but the Japanese chestnut, *C. crenata*, was found to be quite resistant, a fact which suggested the Asiatic origin of the parasite. It has now been fully demonstrated that it is a native of China, where it causes a limb canker and does some injury, but never approaches the destructiveness it has shown in America. It was, therefore, probably through some unimportant introduction of Japanese or Chinese chestnuts that *Endothia parasitica* came to the United States, a weighty matter, however, when we think that it was estimated to have cost $50,000,000 up to 1912, and that it threatens to destroy every chestnut forest in the United States.

Europe should take warning and exercise every precaution to prevent

the introduction of this disease before it is too late to save its valuable chestnut forests. Still more important is it for all countries to join in a study of the plant parasites of the Orient, for it is certain that others exist there which imperil our future, and only thorough surveys and investigations by specialists can give warning in time to prevent repetitions of the San José scale and chestnut bark disease disasters.

Many additional examples could be cited of parasites which have assumed a more destructive rôle when carried to another continent, but enough have been mentioned to emphasize the point that this factor should be considered in all plans for international action. Legislation relating to inspection services and conventions between nations should recognize that a given parasite does not threaten all nations equally, and that each country must guard itself more carefully against invaders from overseas than from those of neighboring lands. Legislation cannot safely proceed in advance of knowledge except in the direction of greater precaution. Scientific investigation needs far greater support than it receives at present, and is indeed an indispensable part of the international program of action.

STUDY OF ENVIRONMENTAL INFLUENCES

While the evolutionary viewpoint just outlined is a helpful guide in our attempt to detect in advance and separate the dangerous parasites from the commonplace, the physiological effect of environmental factors on plant diseases must not be lost sight of. Temperature and humidity, in particular, often restrict the range of fungous diseases. That apples in Europe are little injured by bitter rot (*Glomerella cingulata*), a disease immensely destructive in the central United States, may be explainable by the high temperature required for infection. *Phytophthora infestans*, on the contrary, has a lower optimum and cannot develop in hot weather. Such facts, when determined with exactness, may allay needless alarm as to the danger from a given disease.

It should be the aim of international phytopathology to ascertain the factors limiting the spread of parasites with greater precision than is the case at present.

THE INTERNATIONAL VIEWPOINT

There are many problems which can be carried farther by international coöperation than by a single country. The discovery of fundamental principles may best be accomplished by men whose broad experience in several countries enables them to coördinate scattered observations, as Darwin and Wallace each were led to the thought of natural selection by their travels in foreign lands, and found there much of the material they brought to the support of the theory of organic evolution.

So we propose for the advancement of phytopathology, that through the mediation of the International Institute at Rome, there be brought about an exchange of specialists between the various countries of the world. This should have for one of its specific objects a world wide survey of plant diseases and insects injurious to vegetation. Whenever an investigator attains distinction as an authority on a particular group of fungi or insects, he should be assisted in extending his studies to other countries in order that the resulting monographs may be complete. Phytopathologists who have specialized on the diseases of one crop plant, like the potato, or barley or wheat, should be enabled to compare conditions in other lands, as it is only by such means that we can avoid the confusion that results from finding in the literature the same disease described under different names and different diseases under the same names by workers who have not understood the variations in local conditions.

A world-wide survey such as here proposed would be very greatly facilitated by improved and extended local surveys made by the government of each country, along the general lines followed at present in Germany and the United States. The purpose of such surveys is (1) to record the distribution of diseases of plants and their annual prevalence in each section of the country; (2) to estimate the amount of loss suffered each year, in order that the economic importance of the subject may be understood; (3) to discover the introduction into the country of new and possibly dangerous diseases, to the end that restrictive measures may be advised; (4) to study epidemics of plant diseases in relation to weather, crop distribution and other factors, and to obtain a better knowledge of the condition governing the development, spread and control of such outbreaks; (5) to gather data respecting the resistance and susceptibility of varieties to disease, for comparison of reports from different sections and correlation with climatological records; (6) to develop closer relations between phytopathologists, to build up mycological collections, to illustrate the geographical range of plant parasites, and to publish from time to time special articles or monographs on this subject.

Where governments have not yet developed their scientific service to a point where this is practicable, as in some parts of Asia, Africa, and South America, the International Institute should secure additional coöperation, for it is precisely from these countries that as already pointed out, the greatest dangers are to be feared.

The execution of these plans does not involve the establishment of any special international stations for phytopathology. Well equipped laboratories already exist in nearly all countries. There are in the United States alone over fifty where work on these problems is under way and where visiting specialists representing the International Institute of Agriculture

or a coöperating government would be welcomed and given the necessary facilities for their work. These stations, extending as they do from the nearly sub-tropical climate of Florida to the cold north and from the desert to regions of abnormal precipitation, present every variety of climate and of soil that can be found in the temperate zone.

An understanding of international phytopathology can be attained only by travel and study in foreign countries. The worker who remains in a single station can never acquire it.

INTERNATIONAL COÖPERATION FOR THE CONTROL OF ESTABLISHED DISEASES

The subject as thus far discussed has related to the discovery and exclusion of dangerous parasites. The control of diseases already established is to some extent a local problem to be carried out at existing stations. The measures to be recommended depend on local conditions of climate, soil, labor costs, etc., and vary somewhat from place to place.

There is, nevertheless, a field for international effort here. The exchange of pathologists will bring to each country the best methods of other lands, more effectively than publications. Through this means also, the biological method of disease control may be applied. A search can be made for the best resistant varieties, to be used for hybridization or as stocks for grafting, and the breeding of resistant sorts encouraged.

The entomologists, in applying the same principle, will seek in foreign countries the parasites of injurious insects and colonize them in large numbers until they are established in the manner practiced with such notable success by the U. S. Bureau of Entomology.

RELATION OF INTERNATIONAL PHYTOPATHOLOGY TO COMMERCE

Particular attention is called to the fact that the introduction of the destructive pests mentioned in this paper has not come about in connection with any important article of commerce but usually through small experimental importations of foreign plants. Such is likely to be the case in the future also.

Commercial interests in their fear that trade will suffer from the enactment of laws to control the spread of plant diseases overlook the enormous losses to commerce now caused every year by existing diseases, and do not forsee the losses to come in the future from troubles yet unknown.

Legislation or international agreements based on a study of our past experience will secure added protection through the extension of some features of the Berne Convention to allow the relatively free exchange of plants and their products between neighboring states or countries which

provide an adequate and efficient system of inspection against diseases and insects.

In the case of countries situated in different continents, or with reference to a newly introduced disease of a serious nature, more stringent precautions may become necessary. Fundamental investigations should be undertaken from the start.

The ultimate aim is the enrichment of agriculture and horticulture through the interchange of desirable plants with other countries, but this should be accomplished under supervision and without bringing in parasites to menace established crops.

It is deemed possible to encourage the introduction of new plants under restrictions, after investigations have been made, and the further our research is carried the greater freedom may be allowed with safety.

U. S. DEPARTMENT OF AGRICULTURE

INVESTIGATIONS OF TIMOTHY RUST IN NORTH DAKOTA DURING 1913

W. H. Mercer

Timothy rust, *Puccinia phlei-pratensis* Eriks. and Henn., has been so prevalent and destructive in various parts of the state this season as to virtually become a new menace to farmers. This statement is based on facts observed by the writer in traveling over the state on inspection work the past summer and autumn. Along with this superficial observation, considerable laboratory, microscopic, greenhouse, and field data were accumulated by the writer the past year. All the work was done under the supervision of Professor Bolley, phytopathologist at the North Dakota Experiment Station.

With regard to the field observations over the state, it may be said in passing that they harmonize exactly so far with the facts observed in the greenhouse and field inspection work and with the results obtained by Eriksson and Henning (Zeitschr. Pflanzenkr. 1894). The above investigators questioned the existence of an aecidial host and thought the disease started each spring in the neighborhood of Stockholm from hibernating mycelium. There was a period of about one month only when there were no new pustules forming, a condition which is quite different in North Dakota. Here the fungus is not very active until late in July and uredospores are very difficult to find after the first hard freeze. They do not state whether new pustules appeared in the spring on timothy plants that had lived over winter or on new growth. In this country the new pustules in the summer are on new growths of timothy in all cases.

The spreading and destructiveness of the disease has been little short of phenomenal. It was probably reported the first time from North Dakota by Johnson in 1911. My notes on one field will indicate the damage done the past season. A fine field of 80 acres of timothy near Larimore showed excessive rust infection on spots as small as a few square rods and up to several acres in extent. The crop was just being cut, and on these rusted spots the quantity and quality of the hay was greatly reduced. In searching for a cause for these areas of rust, a number of weeds in the field were examined for aecidia. The aecidium of Rose rust was the only thing found, apparently in the places most severely affected by timothy rust. This, of course, may have been only a coincidence as it was not so apparent in other fields examined.

The proposition is, where did this timothy rust come from? It has suddenly appeared in the last two or three years. The rate of its spread and its destructiveness this year require that something be done to combat its ravages.

The writer examined other grasses and grains in the near vicinity of the above field for rust infection of any kind. A large field of Blue-stem wheat, growing adjacent to the timothy field, was thoroughly examined for *P. graminis*. None was found except as noted below. In the field was a very small sprinkling of Fife wheat, one plant of which was thoroughly covered with pustules of *P. graminis*. Aside from this, there did not appear to be a pustule of this rust. A few stray timothy plants, growing in the wheat, were entirely free from rust infection, although only fifteen or twenty feet from the extremely rusted timothy field. Some of the grasses examined were: *Agropyron tenerum, Agrostis alba, Stipa spartea, Hordeum jubatum*, and several others not positively identified. No rust infection was noted. An oat field and rye field near the same timothy field also showed no rust infection although well along toward ripening. From the above notes the writer has as yet drawn no conclusions.

With regard to the field and greenhouse infection work, several experiments were tried by the writer and Mr. Grover Edwards, one of our students. In some cases we purposely duplicated each other's work to secure more positive results.

In October, 1912, bundles of rusty timothy straw, bearing both uredo- and teleutospores, were secured and placed in large tin cylinders having both ends covered with wire netting only. These cylinders were exposed to the weather all winter, in such manner that the straw did not become damp. Damp chamber and hanging drop cultures were made from teleuto- and uredospores from these cages, from October, 1912, to March, 1913. In no case did the uredospores germinate positively and the teleutospores only feebly in March. It is possible that the laboratory conditions were not right, all work being done at room temperature.

Again teleutospores from both wheat and timothy straw were sown on barberry leaves under bell jars in the greenhouse. Infection was readily secured from the wheat but none from the timothy rust. In June, 1913, a glass cage was placed over a young barberry in the field, and rusty timothy straw put in on top. It was also sprayed with a water mixture of teleutospores from the same straw, with no positive results.

Infections made on grasses in the greenhouse with barberry aecidiospores from the field resulted as follows:

Triticum vulgare, Fife	Positive
Hordeum jubatum	Positive
Agropyron tenerum	Positive

Phleum pratensis	Negative
Secale cereale, rye	Negative
Agropyron repens	Negative
Bromus inermis	Negative
Poa pratensis	Negative

The above work was duplicated in the fields without taking precautions to prevent outside infection, with identical results. Rye, however, is positively susceptible to barberrry aecidiospore infection as proved by the very heavy rust infection in the immediate vicinity of the barberry bushes in the field breeding plots. Ten feet away there was almost no infection.

In another case fresh uredospores of timothy rust were sown on Fife wheat and uredospores of *P. graminis* from Fife wheat were sown on timothy, giving negative results in all cases. One inoculation in the greenhouse with uredospores from timothy rust (fresh pustules) were made on the following grasses:

Triticum vulgare, Fife	Negative
Secale cereale, winter rye	Negative
Hordeum jubatum	Negative
Poa pratensis	Negative
Agropyron repens	Negative
Bromus inermis	Negative

The above data tend to show that there is no relation between grain and timothy rust, and probably none between the latter and rusts of other grasses mentioned. It also points out a considerable danger from this new menace. Remedies lie naturally along the lines of breeding and selection for resistance, and also in a more thorough study of the life history of the fungus with a view to discovering a vulnerable point of attack by other means, possibly comparable to treatment of smut in wheat.

AGRICULTURAL COLLEGE
NORTH DAKOTA

NOTES ON PERIDERMIUM FROM PENNSYLVANIA[1]

C. R. Orton and J. F. Adams

With Plate III

The rust of sweet fern and sweet gale was described by Arthur[2] in 1906 on *Comptonia peregrina* (L.) Coult. (*C. asplenifolia* Gaertn.) as *Cronartium Comptoniae*. It was reported in the North American Flora as occurring from Canada southward along the Atlantic Coast to North Carolina.

Its aecial stage was connected by Clinton[3] who made sowings of aeciospores from a bark Peridermium on *Pinus rigida* Mill. upon the leaves of *Comptonia asplenifolia* and obtained uredinia. It was supposed that the aecial stage was *Peridermium pyriforme* Peck and it has been reported as such by subsequent workers upon this group of rusts.

In looking over the collections of fungi from the region around State College, Pa., the writers found a specimen of Peridermium on *Pinus rigida* collected in Center County, Pa., by W. A. Buckhout, June 1, 1891. This specimen was very well preserved and clearly shows the marked peridia so well illustrated in Clinton's report.

Last May, Mr. A. R. Gerhart, a forestry student of Pennsylvania State College, brought in another specimen of this Peridermium on *Pinus echinata* Mill., which was collected by him near Bear Meadows, Center County, Pa., May 26, 1913. The specimen was upon the trunk of a young tree about seven years old and extended for about six inches up the trunk.

There appears to be no doubt regarding the determination of these specimens as they have been carefully compared with authentic specimens of this Peridermium on *Pinus rigida* and *Pinus sylvestris* kindly sent by Dr. G. P. Clinton from Connecticut.

The aecial stage is characterized by a perennial mycelium which invades the bark and outer cambium, causing a slight, fusiform swelling. The peridia when in good condition are very conspicuous and show characteristic spiny teeth along their margin after opening (pl. III, fig. 1). The aeciospores are broadly ellipsoid (pl. III, fig. 2) and measure 15 to 21 by 24 to 32μ. It appears to attack only young pines, and on the trunk or lower branches near the ground. In this feature it resembles *Peridermium pyriforme*.

[1] Contributions from the Department of Botany, Pennsylvania State College, No. 1.

[2] Arthur, J. C. New species of Uredineae. Bull. Torrey Bot. Club **33** : 29. 1906.

[3] Clinton, G. P. Connecticut Agric. Exp. Sta. Rept. **1907** : 380–383. 1908.

As has been indicated already the name *Peridermium pyriforme* Peck has been used for this species by various authors, but recently Arthur and Kern[4] have shown conclusively that the genuine *P. pyriforme* of Peck has pyriform spores of a very marked form. This immediately explains why Peck's name cannot longer be used for the Comptonia connection which has broadly-ellipsoid spores. In looking over the field we find that there is no distinctive name for the Peridermium which is the aecial stage of *Cronartium Comptoniae* Arthur,[5] and as it is a matter of considerable convenience in discussing these forms to have a definite, specific name the authors propose the name **Peridermium Comptoniae** (Arthur) comb. nov. Its hosts as now reported are *Pinus austriaca* Höss., *P. echinata* Mill., *P. maritina* Poir., *P. montana* Mill., *P. ponderosa* Dougl., *P. rigida* Mill., *P. sylvestris* L., *P. taeda* L., and *P. virginiana* Mill.

Cronartium Comandrae Peck is an interesting rust both on account of its wide distribution which extends across the northern half of the United States, and because it is the only published species of the genus in America which is at present unconnected by cultures with its aecial stage.

Last May word was brought to the writers that a rust had been observed on pines at Charter Oak, Huntingdon County, Pa., by Messrs. D. C. Babcock, and E. T. Kirk of the Chestnut Blight Commission. On June 2, the writers with Mr. Kirk visited the locality and found abundant specimens of pines being severely attacked on the trunk, close to the ground, by a Peridermium in fresh condition. Specimens were taken and a brief search was made for the alternate stage without success. All of the infected pines were growing on a dry hill exposed on the east, and sheltered on the west by scrub oaks. A careful examination of the infected hosts showed that they were *Pinus pungens* Mill., a species on which heretofore no rust had ever been reported.

One of the striking features of this rust was that in every case but one, of a dozen or more which were seen, the infection was upon the trunks of young trees very close to the ground (pl. III, fig. 3). In the one exception it was upon the lowest branch but not more than 6 inches above the ground. This makes it very inconspicuous especially in the open where the trees are bushy and this doubtless accounts for the fact that it is so rarely collected.

In general appearance it resembled somewhat *Peridermium Comptoniae* as it attacks the host at about the same place and causes only a very slight, if any, swelling. The peridia however were not so well developed as those of *P. Comptoniae*, neither did they have such very prominent tooth-like processes after rupturing.

[4] Arthur, J. C. and Kern, Frank D. The rediscovery of Peridermium pyriforme Peck. Science **38** : 311–312. 1913.

[5] Arthur, J. C. l.c.

On examination of the aeciospores it was noted with surprise that most of them were pyriform in shape and large, measuring 15 to 25 by 45 to 70μ (pl. III, fig. 4), and so the writers were at a loss just what to name the rust until the rediscovery of *Peridermium pyriforme* Peck was made known to them through Dr. Kern just prior to the appearance of Arthur and Kern's paper regarding that species. This explained the situation at once, and so on August 31, Dr. Frank D. Kern with Mr. J. B. Demaree and the senior writer visited the locality at Charter Oak where this rust, which is undoubtedly the real *Peridermium pyriforme*, had been collected on June 2. The real purpose of this trip was to collect the alternate stage which Arthur and Kern had predicted, in their above mentioned note, would be *Cronartium Comandrae* Peck. The search was entirely successful. Dr. Kern found the first specimen of the Cronartium on *Comandra umbellata* among the scrub oaks not more than 40 feet from an infected *Pinus pungens*, and a further search revealed the rust in abundance and always near the edge of the scrub oaks where the most of the infected pines were located. This collection of the two stages in such close proximity, together with the fact that no other Cronartium occurs in just that locality, seems to prove beyond doubt that *Peridermium pyriforme* Peck is the alternate stage of *Cronartium Comandrae* Peck.

Recently Hedgcock and Long[6] have published a new species, *Peridermium Betheli* on *Pinus contorta* Loud. from Colorado. In this description they mention especially the fact that it possesses well-marked pyriform spores and that "the species does not produce galls, or marked hypertrophy of the host." The description compared so closely with that of *Peridermium pyriforme* that the writers obtained specimens of the type collections, very kindly sent by Professor Bethel and compared them with the specimens collected at Charter Oak. There appears to be a smaller number of the pyriform spores on the Colorado specimens than on those from Pennsylvania and they do not average as long. However these variations appear to be characteristic of all specimens of *Peridermium pyriforme* and are probably only physiological variations associated with the particular host upon which this species occurs. It may be said that this variation in size of spores, of a particular species upon various hosts, is extremely common among the rusts. It seems probable, therefore, that *Peridermium Betheli* H. and L. should properly be referred to *Peridermium pyriforme*.

The Coleosporium on Aster and Solidago is one of our most common rusts, and distributed rather generally throughout North America. Its aecial stage, *Peridermium acicolum* Underw. and Earle, has been reported

[6] Hedgcock, G. G. and Long, W. H. Phytopathology **3** : 251–252. 1913.

only upon *Pinus rigida* Mill., but it is one of the most commonly collected species of leaf Peridermium. It has been collected in the vicinity of State College, Pa., several times on *Pinus rigida* and the writers collected it upon *Pinus pungens* Mill., at Charter Oak, Huntingdon County, Pa., on June 2, 1913, at the same time that *Peridermium pyriforme* was collected on the same host. There seems to be no doubt as to its identity as several species of Solidago were found, heavily rusted with the uredinial stage, growing immediately under and around the infected pines. This adds a new host for this species of Peridermium.

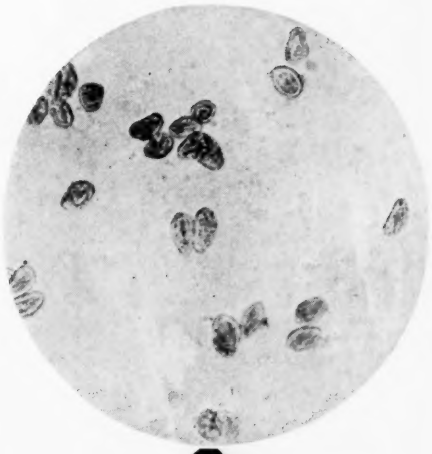
PENNSYLVANIA STATE COLLEGE
STATE COLLEGE, PA.

PLATE III

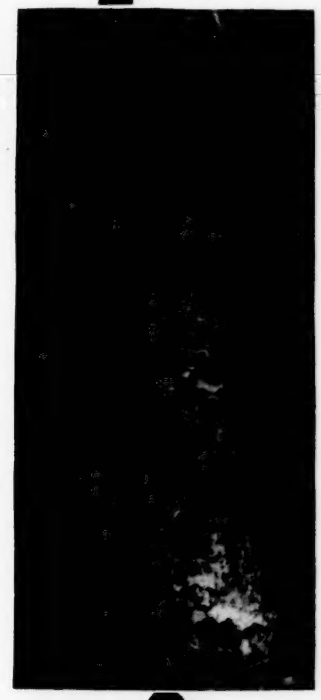
FIG. 1. Peridermium comptoniae on *Pinus rigida*. About natural size.
FIG. 2. Photomicrograph of aeciospores from same. × 250.
FIG. 3. Peridermium pyriforme on *Pinus pungens*. About natural size.
FIG. 4. Photomicrograph of aeciospores from the same showing extreme variation in size and shape. × 250.

C. R. ORTON AND J. F. ADAMS

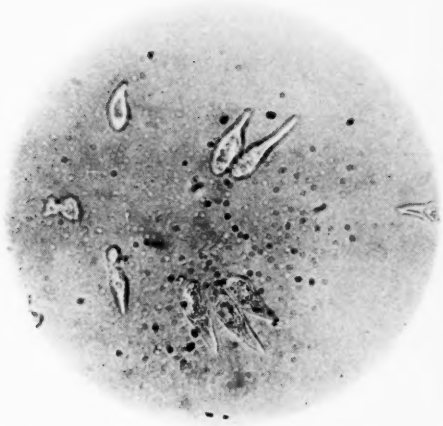
1



2



3



4

AN UNUSUAL OUTBREAK OF APPLE BLOSSOM BLIGHT

GEORGE M. REED

During the month of May, 1913, numerous reports from various parts of the state of Missouri came to the Departments of Botany and Horticulture regarding the occurrence of a "blossom blight" on the apple trees. It was soon found that an unusual outbreak of this bacterial disease of the pear and apple had occurred and that a great deal of damage was being done. An examination of the apple orchards in the vicinity of Columbia also showed the presence of the disease.

As is well known this bacterial disease, caused by *Bacillus amylovorus* (Burrill) de Toni, occurs in three fairly distinct forms. There is first the "fire blight," "twig blight," or "pear blight" in which the young rapidly growing twigs of apple and pear trees wilt, turn brown or blackish, and quickly die (1, 2, 8). The disease may affect only a short portion of the tip or frequently may extend back two or three feet. The blighted twigs have the appearance of being scorched by heat, and hence the origin of one of the common names applied to the disease. Fire blight (3) is known to be particularly injurious to nursery stock of the apple, pear, and quince.

A second form of the disease is the blight canker which has been described by Whetzel (7) on apple trees in New York. According to Whetzel young trees just coming into bearing seem to be most severely injured. The cankers occur on the larger limbs and even the main trunk. Frequently the cankers are found in the crotch where the larger limbs branch off from the main trunk. The cankers are slightly sunken areas, somewhat discolored, and in the rapidly spreading stages are quite watery. From these cankers a sticky, gummy fluid exudes during damp, moist weather.

A third type of the disease is the "blossom blight." In this form of the disease the causal organism invades the floral parts of the trees causing the blighting of the flowers and, of course, a consequent loss of fruit. Blossom blight has been specially reported by Waite (4, 5, 6), and is known to be particularly destructive to the pear. Bees are closely associated with its distribution and the rapid spread through the orchard is due to the fact that the insects carry the bacteria from infected flowers to the healthy. Young quince trees (3) in the nursery, just coming into the blooming period, are also seriously infected with this form of the disease.

Blight canker is quite common on the trunk and larger limbs of the pear in this state. It is not common on the apple. The canker here is not recognized as particularly destructive. However, as the cankers seem to be the place where the organism survives the winter, they are of great importance as a source for the spread of the disease in other forms the following season, for in the early spring these cankers become active again and the characteristic sticky exudation appears in which countless numbers of bacteria are found. As these slimy exudations attract bees and other insects, the bacteria adhere to them and thus are carried far and wide through the orchard.

In Missouri twig blight is very common. Upon the pear it is very destructive appearing practically every season, although it is much worse some years than others. Some varieties of apples, notably the Yellow Transparent, are very susceptible to this twig blight. In the spring of 1908 twig blight was very common on young trees of a number of different varieties, causing the death of a large proportion of the young twigs. Some crab apples are regularly affected.

While twig blight was common enough this year on many varieties of apples it was not present to such an extent as to attract particular attention, except in the case of the Yellow Transparent and Jonathan apples and some pears.

This past season the disease attracted special attention as a blossom blight. Heretofore apple blossom blight has not been common although blossom blight has been reported as injurious to the pear and quince. This year, however, blossom blight of the apple has been reported from many sections of the state.

Prof. W. L. Howard, of the Department of Horticulture, has furnished me with some data which he has obtained from an examination of experimental orchards. He found very serious injury to the Yellow Transparent, Jonathan, Ingram, and York. In the case of the first two varieties, twig blight was prevalent causing great injury to the Yellow Transparent. In certain orchards the crop of Jonathan apples was reduced about one-half by blossom blight. Practically the entire crop of both Ingram and York apples was destroyed. Both varieties bloomed heavily but nearly all the clusters of blossoms were blighted. There was a noticeable absence of twig blight on the York. Professor Howard further found that the Ben Davis, Gano, and Black Ben were free from blight. To some extent this may have been due to the light blossoming of these varieties. In one or two cases the blight was very serious in one orchard but practically absent from an adjacent one.

A somewhat careful study of the blossom blight was made by the writer on the trees on the horticultural grounds of the Experiment Station. A

number of limbs were taken on trees of different varieties and the number of blighted and healthy clusters of blossoms obtained. The counts were made May 27 and 28. The following table indicates the results:

Blossom blight on apple

	BLOSSOMS BLIGHTED	BLOSSOMS NOT BLIGHTED	BLIGHTED BLOSSOMS
			per cent
Ingram	116	2	99
Melonen	91	9	91
Jeneton	55	7	90
Devonshire Duke	81	11	88
Stayman Winesap	21	4	84
Wealthy	62	15	83
Doctor	86	29	75
Pumpkin Sweet	82	17	82
Missing Link	63	17	78
York Imperial	59	25	70
Peach	55	28	66
Louise	57	36	62
Nelson Sweet	120	80	60
Payne's Keeper	25	91	22
Jonathan	22	102	18
Huntsman	7	72	9
Ben Davis	free		0
Ontario	free		0
Early Harvest	free		0
Gano	free		0

As seen from this table some varieties as the Ben Davis, Gano, Early Harvest, and Ontario were entirely free from the blight. The other varieties showed varying degrees of blight, the Ingram, Melonen, Jeneton, Devonshire Duke, and Stayman Winesap being very badly infected. In these cases the effect of the disease was very striking At a considerable distance one could observe a very large number of clusters of leaves which had turned brown and died. These contrasted sharply with the normal green leaves. Closer examination showed that practically all of the flower clusters had blighted and the disease had spread back to the few leaves near the base of each flowering shoot.

In some cases not all the flower clusters on a branch were blighted. Frequently one could find sound, healthy blossoms although other clusters above and below on the same twig had been killed.

The blossom blight was also very common on the pear in the same orchard. The twig blight was also conspicuous. An examination of wild crabs and haws in the vicinity of Columbia also revealed the presence of

a large percentage of blighted flower clusters. This was particularly evident on *Crataegus Crus-galli*.

Perhaps a satisfactory explanation of this unusual outbreak of the blossom blight is hardly possible, as its appearance was so sudden. Two suggestions may be made, however, which may be of some value in accounting for the unusual occurrence of the disease.

The winter of 1912–1913 was exceptionally mild in Missouri. The season was characterized by the relative absence of severe storms and prolonged cold. At the Columbia Weather Bureau Station the lowest temperature recorded during the winter was 1° above zero.

The absence of severe cold weather may have been favorable for the survival of the blight bacteria in cankers. It is possible that fewer organisms than usual in the cankers were killed and in consequence a much larger number survived and thus served for the initial infections upon the return of favorable spring weather.

The second suggestion is based upon the fact that spring was unusually late. The apple trees did not come into bloom until the latter part of April, perhaps two weeks later than usual. Insects, particularly bees, were much more common at this late blooming period. The increased numbers of these may have served to carry the bacteria very widely and thus in a short time spread the blight organism through the orchard.

DEPARTMENT OF BOTANY
UNIVERSITY OF MISSOURI

BIBLIOGRAPHY

1. BURRILL, T. J. Anthrax of fruit trees: or the so-called fire blight of pear and twig blight of apple trees. Proc. Amer. Assoc. Adv. Sci. **29** : 583–597. 1881.
2. JONES, D. H. Bacterial blight of apple, pear, and quince trees. Ontario Agr. Col. Bul. 176 : 1–63. 1909.
3. STEWART, V. B. The fire blight disease in nursery stock. Cornell Agr. Exp. Sta. Bul. 329 : 315–371. 1913.
4. WAITE, M. B. Cause and prevention of pear blight. U. S. Dept. Agr. Yearbook **1895** : 295–300. 1896.
5. WAITE, M. B. Relation of bees to the orchard. California Cultivator **18** : 390–391. 1902.
6. WAITE, M. B. and SMITH, R. E. Pear blight. Ann. Rept. California Fruit Growers Assoc. **31** : 137–161. 1906.
7. WHETZEL, H. H. The blight canker of apple trees. N. Y. (Cornell) Agr. Exp. Sta. Bul. 236 : 104–138. 1906.
8. WHETZEL, H. H. and STEWART, V. B. Fire blight of pears, apples, quinces, etc. N. Y. (Cornell) Agr. Exp. Sta. Bul. 272 : 31–52. 1909.

PHYTOPATHOLOGICAL NOTES

Bacillus amylovorus vs. amylivorus. Dr. V. B. Stewart in Bulletin 329, Cornell University Agricultural Experiment Station (April, 1913), calls attention to the spelling of the specific term in the name of the organism long recognized as the active agent in the disease of pear and apple trees called blight. The word has been spelled since 1882 in perhaps hundreds of publications *amylovorus*. The writer referred to has, however, found that it occurs as *amylivorus* in the American Naturalist (1883) where he thinks the original publication was made. In accordance with this supposition he properly adopts the latter spelling in the bulletin.

As it is a matter of some consequence in the general problem of nomenclature, I state the facts as known to me bearing upon the subject. It ought to be added that I am not aware that Dr. Stewart had all of these before him.

The account of the original investigations by me was read before the American Association for the Advancement of Science in Boston, 1880, and was published in full abstract in the Proceedings for that year. In the paper the organism was compared with *Bacillus amylobacter* (note the spelling) of Van Tieghem, but was not otherwise named. The name *Micrococcus amylovorus* first appeared in print in the Eleventh Report of the Board of Trustees of the Illinois Industrial University for 1882 in connection with a short but, as it has proved, sufficient description, identical in wording with that in the American Naturalist of the next year. The paper in the Trustees' Report (pp. 93–157) was a general one, entitled The Bacteria, and was liberally distributed as "separates," 500 copies having been printed as such. In all my own writings since 1882 upon the subject and in those of all others preceding the date of the bulletin mentioned the "o" has been uniformly used.

Does it not seem evident from the preceding name (amylobacter) with which comparison was made and which may be presumed to have suggested the one in question, from the actual printing the year before (in the Trustees' Report) and from abundant use during thirty years, all with the "o," that the "i" in the American Naturalist was a typographic error? If it clearly was such, need it be now followed? It seems to me we may say: No.

T. J. Burrill.

Specific name of the fire blight organism. It is a great relief to the writer to find that Dr. Burrill has presented a satisfactory basis for retention of the generally accepted spelling of the specific name of the pear blight organism. The survey of the literature on the subject as presented in Bulletin 329 of the Cornell University Agricultural Experiment Station has at least served to bring about from the author of the species himself a definite statement as to the place of original description; a circumstance which unfortunately is not infrequently impossible.

The necessity of a complete bibliographical index of botanical literature as suggested by Dr. Shear in his paper read at the Atlanta meeting is particularly emphasized in this instance. The writer searched carefully through numerous reports of the Illinois Industrial University to determine the first use by Dr. Burrill of the specific name *amylovorus* but even then missed the reference given above by him. That even the Doctor himself had practically forgotten the place of original publication of the species is indicated in the following sentence from a letter from him dated April 5, 1912, in response to an inquiry made shortly before the bulletin was published. "I send you a copy of my original paper as it was read before the Association for the Advancement of Science in 1880, and also what I deemed would be the original description of the pear blight organism published in the American Naturalist in 1883."

That the spelling in the American Naturalist was unquestionably a typographical error is indicated in the following paragraph from a letter from Dr. Burrill acknowledging receipt of a copy of the bulletin and dated June 26, 1912. "Concerning the spelling of *amylivorus*, I was surprised to find a few months ago that I used this spelling in the American Naturalist in what I supposed must be the original description of the species referred to. Everywhere else with me it has been *amylovorus*. I suppose the "i" should have preference."

The existing rules of botanical nomenclature would scarcely permit the change providing the name as printed is not orthographically incorrect. The citation or a different place of original publication however alters the entire situation. It would appear that the occurrence of the description of the new species as found in the Eleventh Report of the Trustees of the Illinois Industrial University constitutes publication. The only remaining question therefore is that of priority of publication. It is a well-known fact that annual reports are frequently very much delayed in publication so that the description in the American Naturalist in 1883 might even antedate that of a report for 1882. Although Dr. Burrill has not established priority for the Illinois report in the above note it is evident that he intends to do so and the same conclusion is more strongly indicated in the following sentence taken from a letter written by him to

Dr. L. R. Jones under date of December 13, 1913. "But in the Eleventh Report of said Trustees, 1882, it is named Micrococus amylovorus, with a short description. The manuscript was prepared during the summer of 1882 and printed some time after the first of October of that year. This was really the original publication if by the latter term the printing in such place may be so called."

It is apparent therefore that we may properly use the combination *Bacillus amylovorus* (Burrill) Trev., citing the following as the original place of publication. Burrill, T. J. Illinois Indust. Univ. Rept. **11**: 134. 1882.

V. B. STEWART.

Fomes laricis in California. Mr. Neal T. Childs, formerly of the United States Forest Service, now adjunct professor of forestry at the University of Nebraska, has sent us a specimen of *Fomes laricis* (Jacq.) Murrill which he collected September 18, 1912, on a living fir, *Abies magnifica* Murr., near Kern River, Kern National Forest, California. He states that there are large amounts of "conky" fir both of this species and of *Abies concolor* (Gord.) Parry in that region, but that this was the only fruiting body found. Hedgcock (PHYTOPATHOLOGY **2**: 78) has also reported this as causing a heart rot of conifers in the west. Of the firs he mentions only *Abies concolor* as being a host of this fungus, so that *A. magnifica* is evidently a new host.

ARTHUR H. GRAVES.

Is golden seal resistant to the root knot nematode? The idea is held by some Michigan growers that golden seal is not liable to attack from the root knot nematode, and therefore, may be grown in infested ginseng beds, thus producing a valuable crop while starving out the nematodes. This question was put to the test as follows during the past summer.

One hundred golden seal plants, obtained from a grower in Tennessee, were set between rows of ginseng in a badly infested bed during June, 1913. In September, 1913, these plants were dug and examined. The new roots were covered with knots and when placed under the microscope, nematodes were found in the dissected tissues.

During October and November, growers from various parts of Michigan sent in samples of golden seal which proved to be badly infected with root knot nematodes.

As a result of these findings, it is concluded that golden seal cannot be used to starve out nematodes in infested ginseng beds.

J. A. MCCLINTOCK.

Identity of the American and French Mulberry blight. In the fall of 1913, through the courtesy of Mr. Arnaud, assistant in the Laboratory of Plant Pathology, No. 11 bis rue d' Alésia, Paris, where I was then studying, I received agar streak cultures of a white bacterial organism isolated by him from blighting mulberry twigs collected in France. He also showed me leaves and twigs blighted by it, the inoculations having been made by him about six weeks earlier on young trees standing in the garden of the laboratory. The signs, external and internal, gross and microscopic, on leaves and stems agreed perfectly with those of our own disease and the agar streak cultures looked exactly like those of our organism. I sent them on to Washington together with some of the infected leaves and stems. From both leaves and stems *Bacterium mori* was isolated in pure culture and inoculated into mulberry shoots in one of our hot houses with production of the typical American mulberry blight, but the agar streaks given me by Mr. Arnaud were lost in transit. In cultural characters and in morphology the French germ agrees with the American one. There can be no doubt, therefore, whatever may be thought respecting the origin of the Italian disease, that the French mulberry blight is identical with our own, i.e., is due to *Bacterium mori* Bayer et Lambert, an emended description of which I published four years ago (Science, 1910, p. 792). In the light of these facts, I think the Italian disease should now be re-examined to see if the yellow *Bacillus cubonianus* is not simply a saprophyte. ERWIN F. SMITH.

Personals. J. H. Muncie, assistant pathologist at the Ohio Agricultural Experiment Station, Wooster, Ohio, has been appointed assistant in plant pathology at the Michigan Agricultural College and Experiment Station, the appointment to take effect November 17. For the present he will work mainly on bean diseases.

Leo E. Melchers, recently a graduate student and assistant in the department of botany at the Ohio State University, Columbus, Ohio, has accepted a position as instructor and assistant plant pathologist at the Kansas State Agricultural College and Experiment Station, Manhattan, Kansas.

Miss Ruth M. Bates, scientific assistant in the office of forest pathology, Bureau of Plant Industry, was married on October 14 to Mr. William Fleming of Hastings, Nebraska. Mrs. Fleming will for the present continue her scientific work at the Forest Products Laboratory, Madison, Wisconsin.

Miss Della E. Ingram has resigned her position as scientific assistant in the office of forest pathology, Bureau of Plant Industry. Miss Ingram

was married on November 19 to Mr. Harry E. Watkins of the Bureau of Plant Industry.

George W. Martin has been appointed assistant in plant pathology at the New Jersey Experiment Station.

G. W. Keitt, scientific assistant in the office of fruit disease investigations, Bureau of Plant Industry, U. S. Department of Agriculture, has accepted the position of lecturer in plant pathology at the University of Wisconsin.

REPORT OF THE FIFTH ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY

The fifth annual meeting of the Society was held in Atlanta, Georgia, December 30, 1913, to January 2, 1914, in conjunction with the American Association for the Advancement of Science.

About fifty members were in attendance and a program of forty-two papers was presented. Twenty-six new members were elected at this meeting, making a total of 271. Joint sessions were held with Section G of the American Association for the Advancement of Science and with the Botanical Society of America.

The following officers were elected for 1914:

President, Haven Metcalf, U. S. Department of Agriculture, Washington, D. C.;

Vice-President, Frank D. Kern, Pennsylvania State College, State College, Pennsylvania;

Councillor, H. R. Fulton, North Carolina College of Agriculture, West Raleigh, North Carolina.

The following were elected chief editors of PHYTOPATHOLOGY: L. R. Jones, one year; C. L. Shear, two years; R. A. Harper, three years.

The regular term of office hereafter is to be three years, the term of one of the chief editors expiring each year.

The following associate editors in place of F. D. Heald, H. Metcalf, E. F. Smith, and F. L. Stevens, whose terms expired, were elected for a term of three years: F. D. Heald, Mel T. Cook, B. M. Duggar, F. C. Stewart.

Donald Reddick was reëlected business manager for one year.

The Society decided to hold its next annual meeting at Philadelphia, Pennsylvania, in conjunction with the American Association for the Advancement of Science.

REPORTS OF COMMITTEES

The Committee on Affiliation and Relation to other Societies, consisting of President Stewart and the Secretary, reported that it had received no communication from the other societies, and therefore no action had been taken.

The Committee on Common Names of Plant Diseases presented the following report, which was accepted, and the committee continued:

The Committee on Common Names for Plant Diseases reports progress and requests that the Committee be continued. It is believed that there has been found a practicable method of procedure for the preparation of a list of names. This will be worked out during the coming year so that definite action on the whole matter may be taken at the next annual meeting of the Society.

F. C. STEWART
E. M. FREEMAN
G. P. CLINTON
H. VON SCHRENK
F. L. STEVENS
Committee

A committee consisting of L. R. Jones, W. A. Orton, and C. L. Shear, which was suggested by the Council and approved by the Society, to consider matters connected with the proposed International Conference on Phytopathology to be held at Rome, reported the following resolution, which was adopted:

Resolved, That the American Phytopathological Society, in convention assembled, regards the proposed International Conference on Phytopathology, to be held in Rome, February 24, 1914, as of the greatest importance in connection with the protection of American Agriculture against plant diseases and insect pests, and it urgently recommends that the United States Government participate in this conference.

The Auditing Committee, consisting of F. D. Heald and H. R. Fulton, reported that they had examined the accounts of the business manager and the treasurer, and found them to be correct.

Upon motion, all the acts of the Council as reported to the Society were approved.

A committee, consisting of F. C. Stewart, C. L. Shear, and Donald Reddick, was appointed, with power to select two other members, or more if desired, to consider possible ways and means of securing further financial aid for the Society and its Journal.

The Committee on Bibliography, consisting of L. R. Jones, R. A. Harper, C. L. Shear, Haven Metcalf, and W. A. Orton was appointed to make arrangements with the Department of Agriculture, if possible, for the preparation of current bibliographical lists of American phytopathological publications, with a view to their regular publication in PHYTOPATHOLOGY.

Upon motion, the matter of the proposed preparation of a complete Bibliography of Botany, as presented by C. L. Shear in his paper, was referred to the same committee.

A committee consisting of Donald Reddick, C. L. Shear, and W. M. Scott was appointed to make arrangements with the Williams and Wilkins Company to undertake the business management of PHYTOPATHOLOGY.

The Society having been informed that Prof. Oscar Brefeld was threatened with the loss of his eyesight, the following resolution was unanimously adopted by the Society, and a copy transmitted to Professor Brefeld:

Resolved, that the American Phytopathological Society, recognizing the important and valuable service of Professor Brefeld to mycology and phytopathology, extend to him its deep sympathy and its full appreciation of his great contributions to our science.

The method of presenting papers by abstract, as carried out at the present meeting, met with very general approval, and was regarded as a great improvement over the previous method. The reading of the abstracts instead of the full papers took but little time and left opportunity for questions and full discussion of the subject. Nearly every paper presented was followed by interesting and valuable questioning and discussion. Upon motion the Society unanimously decided to continue the present method of presenting papers by abstract published before the meeting of the Society. Abstracts should in general not exceed 200 words and should be prepared with a view of presenting as clearly as possible in condensed form the substance and conclusions of the paper. These abstracts should all be in the hands of the Secretary not later than December 10, in order that they may be published and distributed before the annual meeting. They are to be republished in full in PHYTOPATHOLOGY.

The question of presentation of a symposium on some subject at the next meeting was referred to the Council for such action as it considered best.

A notice of the following proposed amendment to the constitution to be voted upon at the next annual meeting is hereby given. Art. III, Sec. 3. "Any person may be-

come a patron upon the payment of $200." It is proposed to change this section so that it shall read "Any person may become a patron upon the payment of $100."

Donald Reddick, business manager of PHYTOPATHOLOGY, presented his account, which showed that after all liabilities were paid there was still a small balance on hand and it had not been found necessary to draw upon the $200 set aside by the Society.

Upon motion, $200 of the Society's funds was continued available for use of PHYTOPATHOLOGY, if found necessary, during the coming year.

The Treasurer presented his report, a condensed statement of which follows: The report was examined and approved by the Auditing Committee:

Receipts

Cash on hand January 1, 1913	$408.29	
Interest on bank deposit for 1913	10.74	
245 membership fees for 1913	735.00	
7 back dues, 1912	21.00	
Exchange on checks	.32	$1,175.35

Disbursements

Clerical assistance during year	$33.56	
Printing, postage, express, etc	143.27	
252 members subscriptions to Bus. Mgr. PHYTOPATHOLOGY	504.00	
Traveling expenses of Secy., Atlanta meeting	35.20	
Check returned uncollectible	5.00	
Cash in bank, December 30	454.32	$1,175.35

The phytopathological exhibit was an interesting and attractive feature of the meeting, as usual.

Following are the abstracts of the papers presented at the meeting.

Fruit rots of egg plant. FREDERICK A. WOLF

A fungus, *Ascochyta hortorium* (Speg.) Smith is responsible for more or less serious losses, in the production of egg plants, in the South. No special study has been made of this disease in the United States except by Halsted of New Jersey. The disease may appear on any of the aerial parts of the plant, being most destructive on the fruits. A study of the morphology, and cultural characters of the fungus has been made.

There has also been noted a heretofore undescribed fruit rot due to species of Rhizoctonia. Cross inoculations with forms of Rhizoctonia from potatoes and tomatoes, together with cultural studies indicate that it is identical with *Corticium vagum* B. & C. Var. *solani* Burt. The fungus excretes an enzyme, pectinase, which causes the dissolution of the middle lamellae and the consequent disintegration of the tissues.

Formaldehyde gas injury to potato tubers. F. C. STEWART and W. O. GLOYER

Potato tubers injured by formaldehyde show depressed areas of dead brown tissue surrounding the lenticels and eyes. Investigation of the conditions under which fumigation with formaldehyde gas results in such injury re ealed the following: Using Morse's formula (3 pints of formalin with 23 ounces of potassium permanganate per 1000 cubic feet and an exposure of twenty-four hours) severe lenticel spotting invariably results if the quantity of potatoes is less than 3 pounds per cubic foot; while with quantities above 12 pounds no injury occurs. By the property of

adsorption the tubers seize and hold the gas upon their surface. If but few potatoes are exposed they adsorb so much gas that injury results; but when the gas is distributed over the surface of a large quantity of tubers it does not gather at any point in sufficient quantity to cause injury. Unsprouted tubers, when injured, usually show only lenticel spotting, but sprouted tubers are very liable also to eye injury. Between 40 and 80° Fahr. the temperature is unimportant. Probably, tubers may show considerable lenticel spotting without being materially injured for seed purposes.

Stem rot and leaf spot of Clematis. W. O. GLOYER

The girdling of the stems of Jackmani and other large-flowering varieties of Clematis near the surface of the ground has been attributed to various causes. The writer has repeatedly found a slow-growing and probably undescribed species of Ascochyta on the leaves and stem lesions of these plants. This fungus lives as a saprophyte on the stem stub of the previous year and numerous pycnidia are here produced. It slowly works downward to the new shoot which becomes girdled, and the portion above then suddenly wilts. New shoots may start repeatedly, but they are killed by the downward progress of the disease.

This same fungus is more often observed causing a leaf spot of *C. paniculata*. It is more prevalent on matted plants lying on the ground than it is on seedlings. Lesions, that cut off the sap flow, may be formed directly on the stem or by the fungus growing down the petiole into the stem. The disease has been produced artificially by inoculating *C. paniculata* with pure cultures of the Ascochyta. It was also produced by spraying *C. paniculata* and *C. jackmani* with spores taken from pure cultures.

A preliminary note on the cause of "pecky" cypress. W. H. LONG

This is a brief discussion of the discovery of the sporophores of a fungus associated with what is popularly known as "pecky" cypress. The fungus is apparently *Fomes geotropus*, a tropical and subtropical species very closely related to *Fomes ulmarius* of Europe. The sporophores are usually located at or near the bases of the trees, though some were found some 12 to 16 feet from the ground. The fungus when it enters through a wound at the butt of the tree produces hollows which may or may not terminate in "peck" further up in the tree. The earlier stages of the rot found in the butts are identical with certain stages of "peck" as seen in the tops. The excessive amount of moisture found at the butts due to the water in which the cypress trees usually grow, produces such favorable conditions for a rapid and vigorous growth of the fungus that all the tissues of the heart wood are destroyed and large hollows are thus produced, while in the tops the fungus grows more slowly and in place of one large continuous hollow, many small isolated longitudinal holes are produced in the wood. Such diseased wood is called "peck." However, it is no uncommon thing to find large hollows in the top terminating at both ends in typical "peck." This fungus was found directly associated with typical peck as well as with the hollow butts of the cypress. Sporophores were found on cypress in five swamps in Florida, two in Louisiana and one in Arkansas. They were also found associated with hollows in the butts of the living trees of six other hosts, to wit: tupelo gum, black gum, sweet gum, elm, maple and magnolia, all swamp trees closely associated with cypress in the southern swamps.

Inspection and certification of potato seed stock. W. A. ORTON

A system of official inspection and certification is proposed to be established in each of the seed-growing states to provide a means for securing better quality in

seed potatoes, with particular reference to freedom from disease, varietal purity, and vigor. This inspection, which would be voluntary and at the request of the grower, would be accomplished through a State agency such as the Experiment Station and protected by suitable legislation penalizing misuse of certificates. The grower should pay the cost of inspection.

The certificates would be based on field inspections of the grower's crop—supplemented by a field test to be carried out in the home State and duplicated in the State where the seed will be sold. Two field visits would be required: the first at blooming time, the second just before the foliage dies in the fall, and in certain cases a third inspection of the stored tubers should be made just prior to shipment.

The requirements for certification should be: uniformity to type; freedom from mixture of other varieties exceeding 1 per cent; uniform size, not over 5 per cent of the tubers shipped weighing less than 2 ounces or over 5 ounces; and freedom from dangerous diseases.

The presence of the following diseases should disqualify for certification: powdery scab, wart, eel worm, Fusarium wilt, Verticillium wilt, southern brown rot and leaf roll. Other diseases should receive special consideration, as follows:

Oospora scab. No potatoes should be included which have any deep scab nor over one-fourth of the surface covered with scabs, nor may the grower deliver stock on which slight scabs occur on more than 10 (?) per cent of the tubers.

The presence of *Rhizoctonia* sclerotia shall be indicated on the certificate and the grower shall not include heavily covered tubers in certified stock.

Silver scurf, if found, shall be mentioned in the certificate.

If more than one-half of 1 per cent of *black leg* occurs in the field, the inspector shall exclude the stock from certification.

The presence of *Phytophthora* in the field shall be reported in the certificate and the purchaser may require a third examination of the stored potatoes prior to shipment.

Freedom from any *Fusarium dry rot* or other types of storage rots cannot be guaranteed except after a special third inspection.

If over 2 per cent of distinct *curly dwarf* is present and if over 5 per cent of hills with weak or poorly developed foliage occurs, or if among the sample hills harvested over 5 per cent yields less than 1 pound of marketable tubers, certification shall be refused for the entire stock.

The fungus genus Verticillium in its relation to plant diseases. W. A. ORTON

Attention is called to the hitherto unsuspected importance of species of Verticillium as causes of plant diseases. The author has already pointed out that a wilt disease of the potato formerly confused with Fusarium is caused by *Verticillium alboatrum*, a trouble worked out by Reinke and Berthold in 1879. The same or a similar fungus has been collected by Orton and Wollenweber on egg plants at Hood River and Medford, Oregon, and in Santa Ana, California, where it caused a serious wilt disease. Pure culture inoculations have been obtained by Wollenweber in Washington.

There are two wilt diseases of okra, one due to *Fusarium vasinfectum*, the other to *Verticillium alboatrum*. The latter is a serious disease in New Jersey, and has been collected also in North Carolina and pure culture inoculations obtained in Washington. This Verticillium is, in general, more northern in its range than the Fusarium wilt of okra.

Klebahn has described a Verticillium disease of dahlia in Germany and Wollenweber has found a root disease of seedling maples in a nursery in Schleswig-Holstein to be associated with Verticillium.

Dr. Wollenweber has in preparation a monograph of this genus along lines similar to his Fusarium monograph, and Mr. C. W. Carpenter of the Bureau of Plant Industry is working with the Verticillium wilt of okra.

A Phoma rot of Irish potatoes. ·I. E. MELHUS

A new storage rot was found prevalent last spring on potatoes grown in Maine. It is caused by a fungus believed to be a species of Phoma. It causes depressed circular areas which vary in diameter from 0.5 to 3 cm., and which often extend down into the center of the tuber. The surface of the infected area is usually discolored and in late stages covered with the black pycnidia of the Phoma. It mars the appearance of the tuber and depreciates its value for both table and seed stock. Results to date indicate that it is a wound parasite, most destructive on potatoes in storage. The fungus grows readily in culture and produces mature spores in less than two weeks.

A new rust of economic importance occurring on pomaceous hosts. H. S. JACKSON

The occurrence of an Aecidium on pear (*Pyrus communis* L.) and quince (*Cydonia vulgaris* (L.) Pers.) in Oregon is discussed. This attacks foliage, fruit, and stems, frequently causing considerable distortion. In some cases 50 per cent of the fruit was affected. What appears to be the same rust also occurs rarely on apple (*Malus malus* (L.) Britton), commonly on native crab apple (*Malus rivularis* (Doug.) Roem.), *Amelanchier florida* Lindl. and Crataegus sp. and has been collected on fruit of *Sorbus sambucifolia* Roem. and *Sorbus hybrida* Linn. as well as flowering crab (*Malus floribunda* Sieb.?).

The distribution of the rust as observed to date is closely associated with the occurrence of *Gymnosporangium blasdaleanum* (Dien. & Holw.) Kern. on *Heyderia decurrens* (Torr.) K. Koch (*Libocedrus decurrens* Torr.). This rust is peculiar, in that the aecial stage is a true Aecidium rather than a Roestelia as in all other species of Gymnosporangium in which the telial stage is known. The Aecidium agrees on all the hosts mentioned above with *Accidium blasdaleanum* Diet. & Holw. as described. While successful culture records are lacking as final proof the writer believes that the Aecidium mentioned above is genetically connected with *Gym. blasdaleanum.* If this opinion should be later proven to be correct, all the plants, except *Amelanchier florida* and Crataegus sp. mentioned above are previously unrecorded hosts for this species.

Notes on the white pine blister rust. PERLEY SPAULDING

The white pine blister rust has appeared several years in the vicinity of Geneva, New York, upon Ribes leaves. In the spring of 1913 the State Horticultural Inspector discovered two white pines bearing fruiting bodies of the fungus, which were about fifteen years old. These evidently have been the center of infection of Ribes in previous years. The rust later appeared on a few *Ribes nigrum* bushes near the two trees. These have been destroyed as have also the pine trees. It is hoped that this eradicates the disease at this point. A similar diseased area was found this summer in northern Vermont. In this case all Ribes of the vicinity have been destroyed and the diseased parts are being removed from the pines as fast as they are found. Two hundred *Ribes nigrum* bushes which were heavily infected with the rust in 1912 were placed in the greenhouse February 1, 1913, and kept there until May 20, but none of the rust appeared upon them. This together with certain experience in the field seems to indicate that the disease is not carried upon dormant Ribes stock. Therefore where the disease is found upon Ribes a special search should be made for the diseased pine which is the center of the infection. In northern Vermont one large white pine tree fully seventy-five years old was found badly diseased in

the top and a number of trees about twenty years old have been found diseased. Their appearance, together with our past experience with this disease, shows that it will take ten to twenty years for the disease to show its full destructiveness. But the disease is just as sure as it is slow and there is no shadow of doubt that it will be the worst enemy of white pine we have if it is allowed to become established and to spread unhindered. *Pinus excelsa* is definitely reported in Denmark as a host for this disease-producing fungus and it has also been found several times this summer on the same host in this country, this being the first time it was found on any pine here but the white pine. Inspection records show that in but one case have all the diseased white pines been removed by the first inspection.

Relation of the mosaic of the pepper and the filiform leaf of the tomato to the mosaic of the tobacco. CARL A. SCHWARZE

The characters of mosaic of tobacco are familiar to all. The characters of the mosaic of the pepper are practically the same. The filiform leaf of the tomato is less well known; it causes reduction of the size of the leaf, frequently to a mere midrib; the blossoms are also affected, the branching excessive and the fruit reduced. There is a great difference in susceptibility of varieties. Small bits of diseased pepper and diseased tomatoes were inserted into healthy tobacco which soon developed true mosaic.

Cladosporium diseases of Ampelopsis tricuspidatum. MEL. T. COOK and GUY WEST WILSON.

The disease attacks the vines causing their death. The organism penetrates the stems, sometimes causing an hypertrophy, but does not fruit in nature. When these diseased stems are kept for a few days in moist chambers the organism comes to the surface and fruits abundantly. The same organism was found fruiting abundantly on mummied berries where it grows apparently as a saphophyte.

It has been determined as *Cladosporium herbarium* Link., and has been reported in this country by Kellerman (Kellerman's Ohio Fungi No. 124) and has also been collected on grapes in California by Newton B. Pierce. Von Thümen records it as occurring on the grapes in Europe. McAlpine reports a similar fungus on grapes in Australia as *C. uvarum*. This disease was common in northern New Jersey and was the cause of a great deal of complaint.

The use of sulphur lime wash as a remedy for apple scab. R. KENT BEATTIE

This paper is a résumé of five years spraying experiments at the Washington Agricultural Experiment Station during the years 1907 to 1911. The serious results of Bordeaux scorch when this fungicide was used has led to the complete replacement of Bordeaux by sulphur lime in the apple orchards of the State of Washington. The experiments show that sulphur lime properly applied twice, gives practically perfect results, i.e., as high as 99.17 per cent clean fruit. In the unsprayed check, the fruit was no more than 6 per cent clean. Attention is called to the necessity of thoroughness and its attainment by the use of the penetration system of orchard spraying.

Cotton anthracnose: Some field problems and some field experiments. H. R. FULTON, J. R. WINSTON and R. O. CROMWELL

The paper discusses the cotton anthracnose situation in North Carolina where the disease is of comparatively recent introduction. The report on experimental work is of a preliminary nature indicating the trend of work in progress. The topics considered are the introduction into new territory, the local spread, factors influencing the seasonal development, the relative susceptibility of varieties and the effectiveness of the seed selection method of control.

Can Cronartium ribicola over-winter on the currant? F. C. STEWART and W. H. RANKIN.

In 1906, 1911 and 1912 *Cronartium ribicola* occurred abundantly in certain currant plantations at Geneva, New York. Prior to 1913 repeated inspection of pines in the vicinity failed to reveal any showing the aecial stage. This led to the suspicion that the fungus over-winters on currants. During the past winter the following test was made: Five hundred plants of *Ribes nigrum* known to have been abundantly infested with Cronartium were divided into six lots and (after a short period of rest) planted in greenhouses in six widely-separated localities, viz., Geneva, New York, Ithaca, New York, Washington, D. C., Lafayette, Indiana, Amherst, Massachusetts, and New Haven, Connecticut. Although the plants were kept under observation from three to four months after the new leaves appeared no Cronartium was seen. Attempts at inoculation by means of affected leaves wintered in wire cages out of doors also failed. The conclusion is that *C. ribicola* rarely, if ever, over-winters on currants.

Finally, the origin of the Geneva outbreaks has been discovered. In May, 1913, two fifteen-year-old white pines were found affected with *Peridermium strobi*, the aecial stage of *C. ribicola*. Apparently, they had been diseased twelve years. They were promptly destroyed.

An improved method of making separation cultures. A. F. BLAKESLEE

Cylindrical specimen jars of quart or half gallon capacity are used as roll tubes. Their large size allows the separation of an increased number of colonies from a single sowing and the cotton plug closing the base of the tube prevents contamination after pouring.

Collar-blight of apple trees in Pennsylvania. C. R. ORTON and J. F. ADAMS

Collar-blight, or "collar-rot," as it is locally known, was first reported from Pennsylvania in May, 1907. It has spread rapidly since that time and is now widespread in the State as well as in neighboring States, being considered the most serious disease of the apple with which the Pennsylvania orchardist has to contend.

The disease appears to be distinct from the "crown-rot" in New York due to winter injury. It is characterized by a progressive death of the bark above and below the ground line and often extends into the root system. The infected tissues become soft and spongy eventually separating from the discolored heartwood.

Young trees, eight to fifteen years old, in orchards where cultivation is practiced, appear most susceptible. No varieties appear to be entirely resistent but some are more so than others.

Inoculations already made by Waite and further work by the writers now underway indicate that *Bacillus amylivorus* (Burr) de Toni is constantly associated with the disease.

The apple-tree borer is probably the most active agent in the spread of the casual organism.

Control measures by the cutting-out method are practical during the early stages of attack.

Fusaria of potatoes. C. D. SHERBAKOFF

The work is a taxomonic study of the species of fungi of the genus Fusarium Link, as they occur on *Solanum tuberosum.*

All isolations were made from the potato plant, mainly from tubers, received from various parts of the United States.

Of all strains isolated in the course of this work, 120 strains which were seemingly

morphologically different were compared on different artificial and natural media. The comparison showed that about 70 of the above strains were morphologically mere fluctuations. Many of the remaining 50 were positively identified with the Fusaria previously described by Dr. Wollenweber, namely, *F. solani*, *F. marti*, *F. coerulium*, *F. metachroum*, *F. subulatum*, and *F. oxysporium*. *F. tricothecioides* Woll. was also isolated though not studied.

For a natural classification of these fungi the following characters are found to be important in order of their arrangement:

(1) Type of the spores, straight and curved, cylindrical, wedge and circle shaped, etc.; (2) type of spore curvature; (3) color type of spores and mycelium; (4) type of chlamydospores; (5) form of tip and base of the spores; (6) spore septation; (7) presence and character of "sclerotia," etc.; (8) gross macroscopical characters; (9) size of spores. Certain of these fungi produce such different types of spores, even on the same medium, that they might be classified in two different genera. But when analogous types of the spores are compared, even the stability of size is usually rather surprising.

The work in general confirms the principle laid down by Appel and Wollenweber in their "Grundlagen."

Some points in the life history of Phytophthora on ginseng. J. ROSENBAUM

Hanai, a Japanese pathologist, in 1900 reported a Phytophthora as causing a disease of ginseng, *Panax quinquefolia*. Hori, Van Hook, Whetzel and the writer, likewise associated this organism with a disease of the ginseng tops. During the past summer it was proved definitely that the disease on the leaves and stems, and a very serious root disease is caused by the same organism. Certain facts were established in connection with the life history of the parasite. They are:

1. The Phytophthora organism may first appear on the tops, work its way down by way of the stem and eventually rot the root.

2. The conidia of the Phytophthora may be washed down into the soil, infect and rot the root, provided the latter is not too deep below the surface.

3. The Phytophthora may first appear on the root. After rotting this in whole or in part, it may travel upwards by way of the stem and thus appear in the tops.

Comparative dusting and spraying experiments. F. M. BLODGETT

Since there was reason to believe that the fungicidal value of lime-sulphur is due in part or largely to the fine sulphur deposited on the leaves, it was thought that it should be possible to approximate the results obtained with lime-sulphur solution by applying finely ground sulphur instead and thus to avoid the burning of tender foliage. Experiments were, therefore, carried out with a mixture of sulphur and arsenate of lead applied as a powder and also in suspension in water as a liquid spray in comparison with regular lime-sulphur applications for the control of apple scab.

The dustings with sulphur and the sulphur in suspension in water controlled scab to a very large extent closely approximating that of lime-sulphur solution. The control of insects was best on the dusted plat and the apples from this block graded best commercially.

Sphaeropsis canker of Quercus prinus. W. H. RANKIN

This disease was found causing the death of numerous chestnut oaks at Yonkers, New York, in July, 1912. Over half of the foliage was dead. The larger amount of the infection had occurred at the base of the current season's growth, although numerous cankers on older limbs were found. Isolations gave uniformly the same organisms. Inoculations on chestnut oaks produced cankers in 47 days, averaging 11 by 2 cm.

A dark streak was also produced for a distance of about 11 cm., above and below the end of the canker, in the first layer of wood. Reisolations from the canker and from the extreme ends of the discolored wood gave the same organism. Inoculations made at the base of the current season's growth gave 100 per cent infection, causing death of the twigs and leaves in forty days. Cankers renewed growth the next season (1913). Pycnidia of Sphaeropsis type were produced in abundance. No perithecial stage has been found. The pathogen proved to be a species of Sphaeropsis having hyaline, one-celled, elliptical spores as well as greenish-brown and two-celled brown spores, measuring about 13 by 27 microns. Morphologically it agrees with *Sphaeropsis malorum* Berk. as this species is now limited. Peck's species *S. abundans* described on chestnut oak has smaller spores. The disease above described is evidently the one reported by Miss Della Ingram in PHYTOPATHOLOGY **2**:96. 1912.

Biological strains of Sphaeropsis malorum. L. R. HESLER

Studies of Sphaeropsis from fifteen different host-plants have extended over a period of four years. Cross inoculations have resulted variously, but in general positive results were obtained on such cultivated hosts as apple, pear, quince and crab apple, whereas negative results were obtained on the several wild plants, including sumac, mulberry, elm, elder, pine, maple, ash, etc. Pedigreed cultures of a given strain show as wide morphological variation as do the several strains from different hosts. A similar tendency is exhibited with respect to biological relationships. The results indicate that on several of the host plants under consideration there is one large species embracing many biological races.

Decay of celery in storage. D. REDDICK

Experimental tests were made to determine the effect of the late blight disease caused by *Septoria petroselina* on the keeping qualities of celery when stored under modern refrigerating conditions. Badly infected celery was stored at a temperature of 31° Fahr. from October 15 to December 23, 1912, with no appreciable spread of the disease.

On November 16, 1912, a carload of celery received a few weeks previous in good condition and stored at a temperature of 31 to 32° Fahr. showed signs of deterioration. On November 22 the tops were in an advanced stage of decomposition. The trouble began in cracks at the base of leaflets and in spots at various places on the stalk, possibly about the injuries of tanished plant bugs. The lesions may appear reddish hence the name pink rot is often applied; they increase in size rapidly, become very soft and turn brown. Isolations from many lesions gave numerous cultures of a Sclerotinia. Sclerotia placed on moist sand yielded apothecia of *Sclerotinia libertiana*. Cultures from ascospores were obtained which were used for inoculations in 1913 with positive results.

A destructive nematode introduced into the United States. L. P. BYARS

While examining bulbs in the bulb garden of the United States Department of Agriculture at Bellingham, Washington, during the past summer, a disease, new to this country, was found occurring to a limited extent on the hyacinths. The malady is due to a bulb and stem-infesting nematode or eel worm, *Tylenchus dipsaci* Kühn., (*Tylenchus devastatrix* Kühn.) known in Europe since 1858 as a pest on alfalfa, clover, rye, oats, onions, potatoes, hyacinths and numerous other wild and cultivated plants, but which has not previously been authentically reported in America.

On the aerial portions of its hosts the nematode produces characteristic distortions and yellow to brown longitudinal discolorations which clearly indicate the presence of the parasite. In the hyacinth, it migrates at the end of the growing

season, from the leaves to the bulb. Entire scales are infested and discolored by the worms so that a diseased bulb in cross sections present one or more characteristic yellow rings.

The adult worm is about one-fifteenth of an inch long, and though barely discernible to the unaided eye, it is readily seen with a hand lens. Each female produces numerous eggs which hatch directly into worm shaped larvae. The latter reach maturity in a short time, so that many generations are produced during a growing season.

In the case of the hyacinth, the infection is carried directly in the bulbs and spread from plant to plant during the summer by various agencies. In all probability the parasite has been brought from Europe in the imported hyacinth bulbs. Because of the destructive nature of the parasite, it is highly important to eradicate any infection that may be found and make rigid inspections of all imported hyacinth bulbs.

Experiments on the control of certain barley diseases. A. G. JOHNSON

In connection with investigations on the Helminthosporium diseases of barley, certain seed treatments for their control were tested during the past season. One lot of seed used was infested with the covered and loose smuts, as well as by the stripe disease (*Helminthosporium gramineum* Rabh.). This made possible a direct comparison of the efficiency of the treatments in controlling these various diseases. Two different hot water treatments and a number of variations in the use of formaldehyde, including the gaseous treatment, were employed. The control plots averaged 8 to 10 per cent each of covered and loose smut and 20 per cent stripe disease.

The modified hot water seed treatment (five hours cold and fifteen minutes hot water, 52° C.) proved the most generally effective preventive for the various diseases. It controlled the two smuts perfectly and reduced "stripe disease" to less than 1 per cent.

The ordinary formalin seed treatment (1 lb. formalin to 40 gals. water, seed soaked two hours) was highly efficient against stripe disease, reducing same to less than 1 per cent. Covered smut was perfectly controlled and loose smut was reduced to a bare trace. This last named fact, viz., that formalin seed treatment controlled the loose smut so well is especially noteworthy since it has been heretofore supposed that this seed treatment was ineffective against this disease.

The formaldehyde gas treatment proved less efficient than the water solution, and inhibited germination considerably.

Similar tests were conducted with two other lots of seed infested respectively with *Helminthosporium teres* Sacc. and *H. sativum* P. K. B. In both cases the primary infections were reduced although not entirely eliminated. Secondary infections soon made both diseases as general in the treated as in the control plots. This indicates that control measures to be efficient against these two diseases must eliminate the primary infections perfectly.

Some observations and experiments on the black-leg disease of cabbage. M. P. HENDERSON

Two purposes of the past season's work on black-leg in Wisconsin have been to determine: (1) the host range of the fungus on the Cruciferae; and (2) whether it may not also be disseminated with the seed of cabbage.

Inoculations were made on seven genera of the Cruciferae, including fifteen species and four varieties. The seeds were sown in sterile soil, thoroughly wet with a spore suspension made from pure culture and kept moist by the addition of distilled water.

Infections occurred in all but two species—*Lepidium virginicum* and *Capsella bursa-pastoris*.

Mother seed-plants were inoculated at different stages of development of the pods, by spraying with a spore-suspension from pure culture and covering with a bell-jar from twenty-four to forty-eight hours. Infections occurred on leaves, flower-stalks and seed-pods. Lesions developed at various places on the pods, but more frequently at the blossom end.

Three seeds were removed, aseptically, from a green infected pod, and plated out on potato agar. One seed taken from beneath a lesion gave a pure culture of the fungus in three days. The other two remained sterile.

On 71 mother seed-plants set out, in May, by the Onalaska Pickle Company, only 29 were alive one month later and all were badly infected with the black-leg organism. Lesions were abundant on leaves, flower-stalks and seed-pods. The fungus had probably been a chief factor in the killing of the other plants since their withered tissues were dotted with pycnidia.

These observations and experiments suggest: (1) a wide host range for the black-leg organism thus insuring easy and rapid distribution in the field, and (2) that infected seed may also serve as a means of dissemination.

The non-validity of the genus Lasiodiplodia. J. J. TAUBENHAUS

On account of the presence of paraphyses in the pycnidia, Ellis in 1896 created the new genus Lasiodiplodia, thereby distinguishing it from the genus Diplodia. During the past two years my work upon the two known Lasiodiplodias, *L. tubericola* and *L. nigra*, and upon *Diplodia gossypii* and *D. natalensis*, show that the presence of paraphyses is not a constant structure, but may be produced in the genus Diplodia or lost in the genus Lasiodiplodia.

The writer has found *Lasiodiplodia tubericola* to be an active parasite. It was also found that *Lasiodiplodia nigra*, *Diplodia gossypii* and *Diplodia natalensis* may produce similar diseases on the sweet potato as that caused by *L. tubericola*. A close pathological and morphological study of the host infected with the above fungi revealed some very interesting details. *Lasiodiplodia tubericola* forms its pycnidia throughout the interior tissue, or on the epidermis of the host. In the latter case the pycnidia may or may not have hair-like bristles at the mouths. *Lasiodiplodia nigra* on the sweet potato behaves in a similar way, except that the pycnidia seem to be sterile. *Diplodia gossypii* and *Diplodia natalensis* on the sweet potato produce an abundance of fertile pycnidia immediately below the epidermis, but in no other internal part of the host. Moreover, when *D. gossypii* and *D. natalensis* are inoculated on the sweet potato, they produce abundant paraphyses, so that it becomes impossible to distinguish them from Lasiodiplodia. Cut and stained sections of these were submitted to some of our leading mycologists, and they pronounced them to be Lasiodiplodia. On the other hand, *L. tubericola* often produces pycnidia without paraphyses. It seems, therefore, that the fungus Diplodia, under certain conditions of the hosts can either dispense with paraphyses or produce the same. In view of these facts and of the close behavior of the above four fungi on different media, it seems prudent to abolish the genus Lasiodiplodia.

Progress in developing disease-resistant cabbage. L. R. JONES

As reported at the last meeting all other remedies having proved ineffective for the control of the Fusarium or yellows disease of cabbage attention has since 1910 been directed to the possibility of disease resistance. The trials of commercial varieties and of especially selected strains were continued in 1913 on badly infected soil. The

season was such as to induce an unusually severe attack of yellows. Many of the same selected strains of seed tested in 1912 (seed grown in 1911) were tested again in 1913 and gave much the same comparative results as to disease resistance as in 1912, although owing to the more trying weather conditions the mortality of all was somewhat greater. For example, the strain known as B, which in 1912, showed 89 per cent of plants living at the end of the season and 68 per cent forming heads, averaged in 1913 92 per cent living and 48 per cent heading. Another variety A gave in 1912 96 per cent living and 80 per cent heading, in 1913 84 per cent living and 68 per cent heading. Alongside of this, commercial or non-selected strains were practically failures in 1913 as they were in 1912. The resistant heads secured in 1912 and earlier were all of the Danish ball head or winter types. Among the kraut types tested in 1913 Volga proved even more highly resistant than Houser which was the best tested in 1912. Heads of both these and others of the earlier types selected for disease resistance were secured last summer that seed may be grown from them next summer. From the heads collected in 1912 (representing the second generation of selection for disease resistance) a sufficient amount of seed was grown in 1913 to offer for distribution for outside trial purposes in 1914 to any who are in a position to coöperate to this end.

Disease resistance in tobacco to root rot. JAMES JOHNSON

The root-rot of tobacco (*Thielavia basicola*) has recently become of great economic importance to tobacco growers in this country. During the season of 1913 the writer has had opportunity to study the "Burley sick soils" of Ontario and the "deteriorated tobacco soils" of Wisconsin upon which crop failures have become increasingly frequent in late years. The poor crops produced on these soils, heretofore attributed to lack of fertility or moisture, have upon careful examination been found to be largely due to the root rot disease. Root rot now threatens to exterminate the White Burley industry of Ontario, and has become the most serious disease of tobacco growing in Wisconsin. A marked difference in resistance can be observed in different varieties. White Burley, as noted by others, is very susceptible to root rot. Little Dutch, on the other hand, has been found to be very resistant. Connecticut Havana has a resistance approximately intermediate between White Burley and Little Dutch. That differences in resistance may exist within varieties is seemingly apparent from the marked uneveness of many diseased fields. In fields generally sick occasional plants have been found showing full vigor. In White Burley tobacco the "off type" plants seemed relatively immune. In other varieties where there was good reason to believe the seed was "mixed," great unevenness frequently existed. In pedigreed Connecticut Havana seed, inbred at the Wisconsin Station for six years, the plants were all apparently equally diseased. Approximately five thousand acres of diseased fields were scanned for resistant plants, with the result that eighty-four apparently resistant plants were bagged and preserved for seed from twelve different farms in the Burley sections of Ontario. Forty-six plants from seven farms in the cigar tobacco sections of Wisconsin were saved in the same way. The best of these selections will be grown in progeny rows on diseased fields in Ontario and Wisconsin during the summer of 1914, and be used as a basis for further selection and breeding.

Life history of Sphaeropsis malorum Berk. C. L. SHEAR

At the first annual meeting of this society in Boston the writer read a paper giving the life history of *Melanops quercuum* (Schw.) Rehm f. *vitis* Sacc. Pure cultures from single ascospores of this fungus produced pycnidia of a Sphaeropsis which was referred to *S. viticola* Pass. This Sphaeropsis appeared identical morphologically

with *S. malorum* Berk. from apples and led to the conclusion that the perithecial stage of the apple Sphaeropsis was also a form of this same species of Melanops, which is found on dead apple branches.

This conclusion is now confirmed by the production of *Sphaeropsis malorum* in cultures made with single ascospores of *Melanops quercuum* obtained from old apple tree prunings at Vienna, Virginia. Seventeen single ascospores were transferred from plates to tubes of cornmeal agar soon after germination. Sphaeropsis pycnidia were found in only one of these tubes, but in six sub-cultures made by transfer to cornmeal in flasks Sphaeropsis pycnidia and spores were produced. In seven out of sixteen sub-cultures on sterile Melilotus stems pycnidia and spores of *Sphaeropsis malorum* were produced. Of the seventeen single ascospore cultures seven produced Sphaeropsis either in the original culture or in sub-cultures. The other cultures were either sterile, or if the pycnospores were present they were not observed. The pycnospores in these cultures showed the same variations in form, size, color and septation as in those from *M. quercuum* f. *vitis*. They also agree with the Sphaeropsis which is found on a great variety of other woody plants.

Blossom-end rot of tomato. CHARLES BROOKS

The diseased tissue is usually free from foreign organisms. Such bacteria and fungi as are sometimes present in late stages of the rot are unable to produce the disease when inoculated into healthy green tomatoes. The disease is favored by heavy applications of commercial fertilizer and greatly increased by the addition of horse stable manure. It is decreased by sodium nitrate. It is worse on heavy than on light soil. It is favored by lack of water and also by excessive watering. Decreasing the water supply may either check or produce the disease, depending upon the condition of the plants at the time of the change. Lime is a partial preventive and also may serve as a remedial agent on plants already predisposed to the disease.

A little-known disease of chestnut and oak trees. F. D. HEALD

The study of chestnut tree blight in Pennsylvania has brought to light a serious disease of the chestnut due to an entirely different organism. This trouble is not confined to the chestnut but attacks various species of oaks.

Two forms of the disease may be recognized: first, the *canker type*, in which the progress of the fungus is slow, with a pronounced callus formation at the advancing edge of the lesion; second, the *diffuse type*, in which the fungus spreads more rapidly, killing the tissues so quickly that callus formation is not possible. Between these two extreme forms there are, however, intermediate types. In all cases the fungus penetrates wood as well as cortex. In the canker type there is deeper and deeper penetration of the fungus until the tree is girdled, or previous to complete girdling the trunk may become too weak to stand the strain of heavy winds. In the diffuse type the tree succumbs in a much shorter time.

The casual organism, *Strumella coryneoidea*, Dace & Wint., fruits rarely or not at all on the cankers, but a profusion of spores may be found in the diffuse type of the disease.

The trouble has been observed in such widely separated localities in Pennsylvania as to justify the belief that it is quite general in the forests of the State.

A preliminary report on fruit infection of the peach by means of inoculations with Cladosporium carpophilum Thüm. *from peach twigs.* G. W. KEITT

Previous literature. No authentic reports of artificially induced peach "scab" have been recorded, the literature of the disease being confined chiefly to descriptions, field notes, and control measures.

Special difficulties encountered. (1) the abundance of natural infection; (2) the slowness of infection; (3) the length of the period of "latent infection."

Special methods consequently employed. (1) bagging the fruits; (2) making large numbers of control experiments; (3) inoculating areas normally free from infection, even on badly diseased fruits; (4) using a special device for moistening the areas of inoculation and control.

Technique of inoculations. Elberta fruits were bagged May 8, 1913. The spores were applied in suspension in sterile distilled water (in a few cases, dilute prune decoction was used) from sterile atomizers to marked areas upon the weather and leeward equatorial surfaces of the fruits. The equatorial areas were kept intermittently moist until maturity, while the fruits remained shielded from natural infection by the bags. 174 inoculations were made in four corroborative series on May 16, May 20, May 27, and June 6, respectively.

Sources of infection. Besides the inoculations with *Cladosporium carpophilum* Thüm. from peach twigs, parallel experiments were made with three apparently saprophytic imperfect fungi, which frequently occur superficially on twig lesions, but also upon normal twig surfaces. The spores were taken from single-spore pure cultures and directly from the twigs.

Results. On the 48 areas inoculated with the superficial imperfecti, no infection resulted. Consequently, these areas are considered as supplementary controls.

On the 100 control areas of the four series, not one infection developed.

On the 18 areas inoculated with spores from single-spore pure cultures of *Cladosporium carpophilum* Thüm. from peach twigs, 707 typical "scab" infections occurred, only one area failing to develop definite infection.

On the six areas directly inoculated with spores of *Cladosporium carpophilum* Thüm. from twig lesions, 63 typical infections developed, every inoculation resulting in definite infection.

Some recent studies on new or little known diseases of the sweet potato. J. J. TAUBENHAUS

As a result of our studies three distinct forms of black rot have been distinguished:

1. *Black rot* (*Sphaeronema fimbriatum* [E. & H.] Sacc.) formerly stated to destroy the entire potato, but recent studies have shown that with the exception of deep cuts, the disease unless associated with other parasitic fungi never goes deeper than the cambium. This form of black rot is the one generally recognized by both layman and scientist.

2. *Charcoal rot* (*Sclerotium bataticola* Taub.) This form of rot is usually attributed to heat, scalding, or to freezing in the store house. Charcoal rot is of considerable economic importance. The disease is most abundant in overheated store houses and in bins nearest to the fire stoves.

Java black rot (*Lasiodiplodia tubericola* E. & E.) This form of disease was found in abundance three years ago on stored sweet potatoes in Delaware but has not been observed since. It resembles somewhat the charcoal rot but does not contain the minute sclerotia in the affected tissue which characterizes the charcoal rot.

Stem rot. This disease was thought to be due to *Nectria ipomoeae* by Halsted but has recently been attributed to *Fusarium batatis* Woll. by Harter. Our own work confirms that of Harter. The term stem rot is misleading as the disease does not produce a typical rot on the stem but merely a browning and darkening of the interior tissue. The disease cannot always be recognized as a stem rot particularly in the case of late infection of the roots. The disease is carried with the seed and in the soil, and is now threatening the sweet potato industry of both New Jersey and Delaware.

Ring rot. There is great loss in storage from a disease known as ring rot. Work on old material always yielded *Trichoderma köningi* or *Fusarium batatis*, both active parasites but not able to reproduce the ring rot. Our recent studies on fresh material in the storehouse indicate that the disease is a form of soft rot (*Rhizopus nigricans* Ehr.). It seems that through some unequal ripening there results in the same root areas of more sugars or enzyme activity which prohibits the invasion of the fungus and restrict its growth to spots in the form of a ring. In two or three weeks the fungus (*Rhizopus*) of the ringed portion loses its vitality. In the meantime other fungi gain entrance so that in working with somewhat old material the primary cause is obliterated and pure cultures of the secondary invaders are easily obtained.

Foliage diseases. Of the foliage diseases the white rust (*Cystopus ipomoeae-panduranae* Farl.) is of considerable importance. It is most prevalent during the hot weather and moist cool evenings. Leaves in the center of the hill are killed first. This dying is erroneously attributed by growers to the setting of the hills.

A new leaf spot. A new leaf spot has been observed for the first time by the writer. The disease is characterized by minute white spots ranging from $\frac{1}{8}$ to $\frac{1}{3}$ inch in diameter and bordered with a brown area. Upon close observation a few minute pycnidia are found on each spot. The former readily drop out. The disease is attributed to what appears to be a new species of Septoria.

Wind dissemination of ascospores of the chestnut blight fungus. F. D. HEALD, M. W. GARDNER and R. A. STUDHALTER

Previous work on wind dissemination of the ascospores of *Endothia parasitica* (Murr.) And. by the aspirator and exposure plate method in the field yielded positive results only under artificial conditions. A series of experiments was carried out near West Chester, Pennsylvania, for thirty-six consecutive days, under absolutely natural conditions, in a badly diseased stand of chestnut coppice.

Of the 756 exposure plates made at intervals of a half hour or less during the day, only those exposed within several hours after a rain developed colonies of the blight fungus. Many of the plates gave almost pure cultures. The maximum distance to leeward of any chestnut trees at which viable spores were caught in agar plates was 365 feet. By means of spore traps it was determined that ascospore expulsion continued from two to ten hours after cessation of rain.

Prolonged exposures were also made of sterile water in shallow dishes. When plated out, colonies of the blight fungus developed in abundance, in two instances from dishes located over 380 feet from the nearest chestnut tree. Positive results were also obtained by plating out sugar tubes through which known quantities of air had been drawn by means of an aspirator.

Longevity of pycnospores of the chestnut blight fungus in soil. M. W. GARDNER

Study of the chestnut blight fungus has revealed the fact that pycnospores in great numbers are washed down the trunks of diseased trees into the soil during every rain. The purpose of the work here reported was to determine the power of resistance of these pycnospores to desiccation in the soil under two conditions; first, in the field during the intervals between rains; second, during a more prolonged period of drying in the laboratory.

In the field tests, samples of soil were taken from the bases of diseased trees after a rain and later after intervals of dry weather. These were tested by poured plate cultures. After thirteen days of drying, the tests gave varying percentages of viable spores, ranging in numbers from 84,000 to 2,412,000 per gram of soil.

Soil samples collected after a rain and stored in the laboratory to secure longer periods of desiccation were tested by poured plate cultures when collected and at convenient intervals thereafter. There was a more or less gradual decrease in the numbers of viable spores, the longevity limit varying from fifty-four to one hundred and nineteen days. Pycnospores in numbers ranging from 11,000 to 204,000 per gram of soil survived two months of desiccation.

The relation of temperature to the expulsion of ascospores of Endothia parasitica. R. C. WALTON

Other workers have determined that the expulsion of ascospores of the chestnut blight fungus takes place only when the pustules are moist and there is a film of water over the ostioles. The study here reported has been made by both field and laboratory tests.

The field tests were based on observations made on 50 ascospore traps set on diseased trees at West Chester, Pennsylvania; and on a like number at Martic Forge, Pennsylvania. At West Chester, from November 26, 1912, to March 20, 1913, there were 21 rain periods with maximum temperatures during or immediately following the rain, of 35 to 60° Fahr. In general there was no expulsion of ascospores.

In the laboratory, spore expulsion was tested at various temperatures ranging from 36 to 100° Fahr. Pieces of bark 1 by 3½ inches, bearing an abundance of perithecial stromata, were placed in shallow trays, and object slides suspended over them. The bark was kept moist and records taken once a day. A control at favorable temperature was used with each set. At the lowest temperatures employed there was no expulsion of spores, but at higher temperatures there was a gradual increase in amount until the optimum was reached, beyond which the expulsion gradually lessened.

Insects as carriers of the chestnut blight fungus. R. A. STUDHALTER

During last winter and spring 75 insects were tested for their ability to carry spores of the chestnut blight fungus. Of this number 21 were ants which had been permitted to run over pycnidial or perithecial pustules in the laboratory or insectary. Cultures from 5 of these ants developed colonies of *Endothia parasitica.* The remaining 54 insects, representing 5 different orders, were taken directly from diseased trees in the field. Of this number 19 were found to be carrying spores of the blight fungus.

The number of viable spores carried as determined by poured plate cultures ranged from 74 to 336,960 per insect. The 3 insects yielding over 7000 spores were *Leptostylus maculata,* one of the beetles which feeds on the pustules. The 8 individuals of this species tested gave positive results and it was demonstrated that the spores were easily shaken from their bodies by their own movements. These facts suggest that this beetle is an important agent in the dissemination of spores of the blight fungus.

In the case of the insects giving positive results, the water in which they were washed was preserved and centrifuged. A microscopic examination of the sediments obtained always showed the presence of pycnospores, and sometimes ascospores also, but the former were more abundant.

Perithecia in cultures of Venturia inequalis. FRED R. JONES

In the course of a study of the apple scab fungus, *Venturia inequalis,* cultures were obtained from ascospores produced on apple leaves found in an orchard at Madison, Wis., on May 9, 1913, and also from ascospores of what appears to be the same species from leaves of the wild crab, *Pyrus coronaria.* On June 26 these cultures

were transferred to various media, including oatmeal agar. In order to keep them from drying out, the cultures were kept in a refrigerator at about 10° C. In the autumn the mycelium completely covered the agar which had shrunken sonewhat from the sides of the tube. On November 27 black dots were noted on and in the agar. An examination showed them to be perithecia produced in great abundance, the majority of them mature and ready to discharge their spores when placed in water. The spores thus obtained germinated readily in water and on culture media.

Gum formation in citrus as induced by chemicals. B. F. FLOYD

Twenty-eight different organic and inorganic chemicals were used in an experiment to induce gum formation. They were inserted into the trunk of young budded citrus trees. Thirteen of this number induced a formation of gum which was produced in the live tissue bordering that killed by the chemical. The chemicals inducing gum flow were acids, alkalies and salts of the heavy metals.

The most copious production of gum was induced by copper sulphate and other salts of heavy metals, the injury extending from the point of insertion into its branches. The amount of gum induced by the other chemicals was small, and was associated with the tissue injury which was confined to the region of insertion.

In all cases, the gum produced was the same in character and appearance, being transparent and turning to an amber or brownish color.

A microscopical examination showed that in all cases the gum originated in the live unlignified xylem tissue, usually in that adjacent to the dead areas. In the case of gum production by the salts of the heavy metals, gum formation was induced in succulent terminal branches which showed no tissue killed by the chemicals.

Bibliographical citations. C. L. SHEAR

The great amount of space occupied at present in botanical journals by bibliographical lists and the immense amount of time and energy required for their accurate preparation and publication suggests the urgent need, in the interests of economy and efficiency, of securing some means of relief.

It is suggested that a united effort be made by all botanists to secure the compilation and publication of a complete bibliography of botany. This, aside from its general usefulness in all botanical work, could, if the titles were arranged alphabetically by authors and numbered consecutively, as is usually the case, be used in the citation of literature, instead of reprinting at the end of each paper all the titles and a full list of publications cited. These frequently cover from one to three pages. The number which the article to be cited bears in the bibliography of botany would follow the author's name where it is mentioned in the text and the page referred to could also be added if desired. The reader wishing to find the complete title and place of publication cited would refer to the author and number in the bibliography, which would of course be found in all scientific libraries and research institutions, and should be published in such a manner as to be available at cost to individual investigators.

With the great number of general and special botanical bibliographies at present available as a basis, the compilation and preparation of a compact, complete bibliography of botany could be accomplished under proper direction in a reasonable period. It could be kept up to date by annual supplements. The federal government through the Congressional Library and its special libraries and investigators is well equipped for this work, and would be amply repaid by its savings in printing and the valuable time of its specialists.

A study of the annual recurrence of Phytophthora infestans. I. E. MELHUS

Over 400 potato tubers that were infected with *Phytophthora infestans* were planted under field conditions in northern Maine. In this locality climatic conditions are favorable for the annual recurrence of late blight. The land that was used in this experiment had not grown a crop of potatotes in the last five years. Some of the diseased tubers produced plants which became infected by the mycelium in the parent tubers produced plants which became infected by the mycelium in the parent tuber migrating into the shoots and running up the stem to the surface of the soil. Above the surface of the soil the fungus sporulated and infected the foliage of neighboring shoots in the same and adjoining hills. An outbreak of Phytophthora resulted such as commonly occurs in northern Maine where no attempt is made to control it. It was demonstrated by this field test that seed potatoes infected with *Phytophthora infestans* may function in starting an epidemic of late blight.

Fungous Gummosis of Citrus in California. H. S. FAWCETT

At least four different and distinct so called "gum diseases" of Citrus trees occur in California, *Psorosis, mal di gomma* and two forms of lemon gummosis. The results of a large number of inoculation experiments (with an equal number of checks) indicate that the causal agents in these last two forms of gum disease are fungi, *Pithiacystis citrophthora* and *Botrytis vulgaris*. The two forms may be distinguished each by its own characteristic effect upon the bark. The inoculation experiments also indicate a marked difference in susceptibility of Citrus varieties. To inoculatious with *P. citrophthora* lemon trees were very susceptible, sweet orange trees somewhat less susceptible and some orange trees almost totally resistant. To inoculations with *B. vulgaris*, lemon trees were also quite susceptible but both sweet and sour orange trees were entirely resistant. The injury from inoculation also varied greatly with the age of the trees, certain other fungi were shown to be capable of inducing gum formation when inserted into cuts, but were not able to progress enough to produce diseases. Among these were *Alternaria citri, Penicillium roseum, Coryneum beyerinchii*, and *Fusarium* sp. No effect whatsoever was produced by inserting *Penicillium italicum, P. digitatum, Mucor* sp. nor *Cladosporum* sp. Wounds alone failed to induce visible gumming provided they were kept absolutely free from contamination and free from certain chemical substances. The disease may be largely controlled by avoiding the conditions favorable to infection and by making all new plantings with trees budded high on sour stocks and by trimming out and painting the entire trunk with a concentrated Bordeaux mixture consisting of 1 pound of copper sulphate and 2 pounds of lime to $1\frac{1}{2}$ gallons of water.

C. L. SHEAR,
Secretary-Treasurer

[PHYTOPATHOLOGY for December, 1913, (**3**: 273–313, *pls.* XXIII–XXVIII was issued December 15, 1913.]